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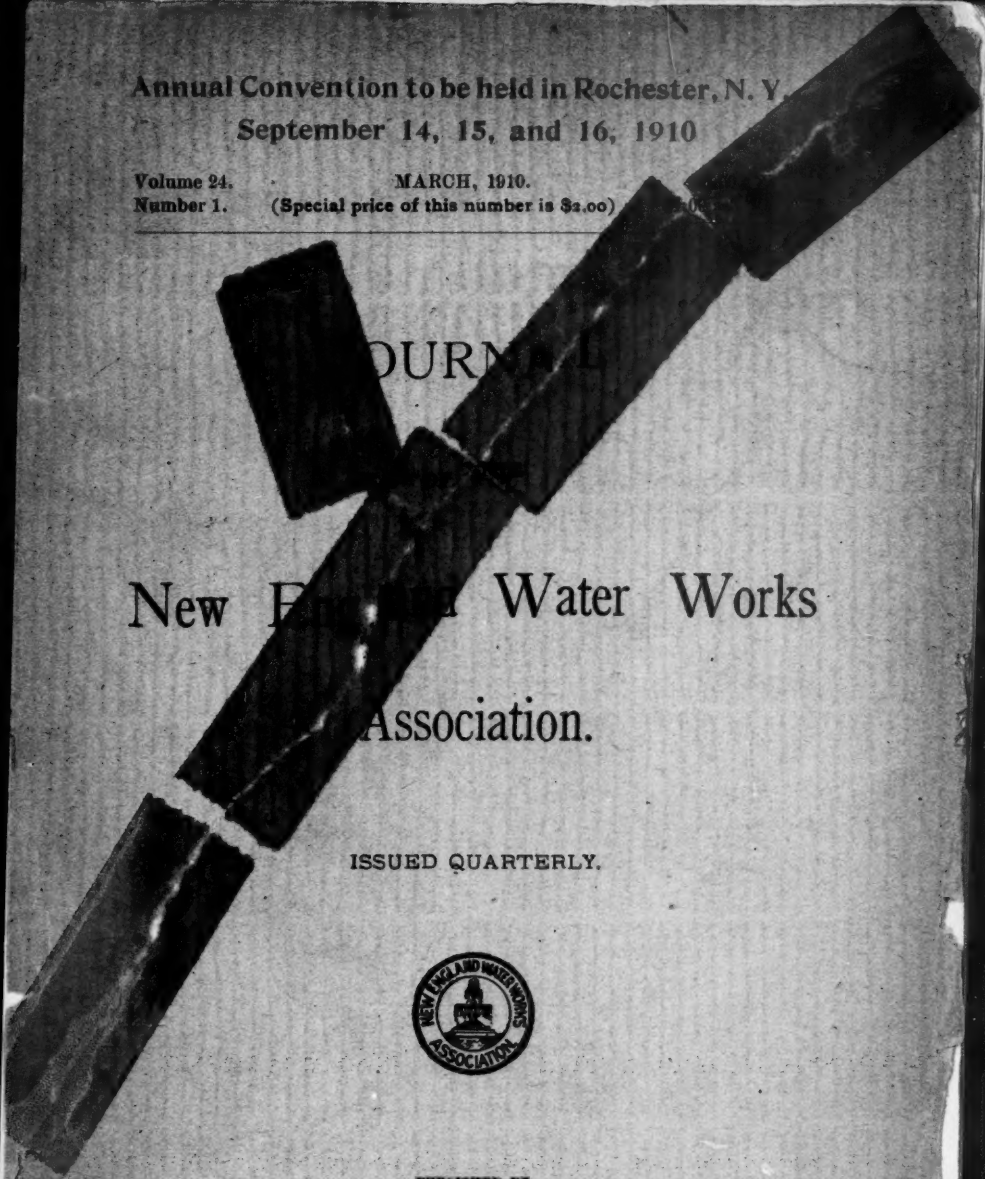

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1910.

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THE ASSOCIATION was organized in Boston, Mass., on June 21, 1882, with the object of providing its members with means of social intercourse and for the exchange of knowledge pertaining to the construction and management of water works. From an original membership of only TWENTY-SEVEN, its growth has prospered until now it includes the names of over 700 men. Its membership is divided into two principal classes, viz.: MEMBERS and ASSOCIATES. Members are divided into two classes, viz.: RESIDENT and NON-RESIDENT,—the former comprising those residing within the limits of New England, while the latter class includes those residing elsewhere. The INITIATION fee for the former class is FIVE dollars; for the latter, THREE dollars. The annual dues for both classes of Active membership are THREE dollars. Associate membership is open to firms or agents of firms engaged in dealing in water works supplies. The initiation fee for Associate membership is TEN dollars, and the annual dues FIFTEEN dollars. This Association has six regular meetings each year, all of which, except the annual convention in September, are held at Boston.

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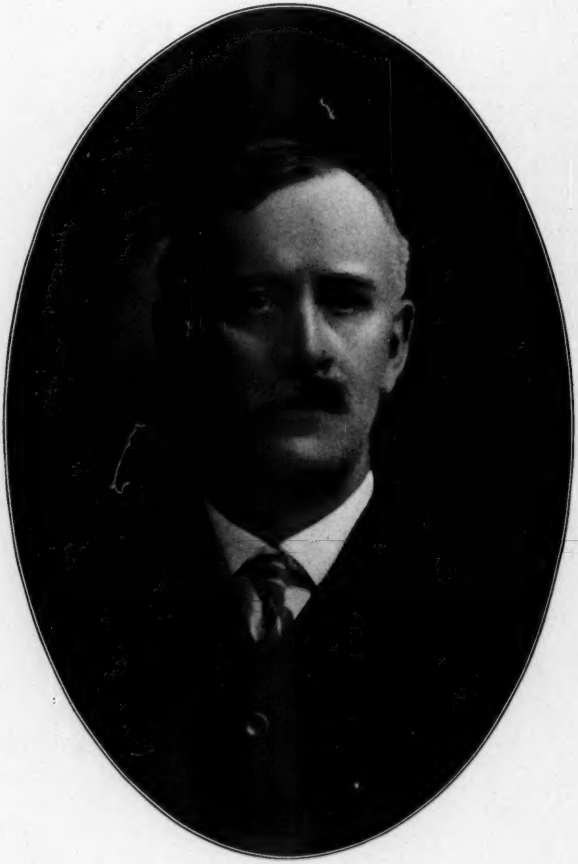

GEORGE A. KING,

President New England Water Works Association,

1910.

NEW ENGLAND WATER WORKS ASSOCIATION.

ORGANIZED 1882.

Vol. XXIV. March, 1910. No. 1.

This Association, as a body, is not responsible for the statements or opinions of any of its members.

REPORT OF COMMITTEE APPOINTED TO COLLECT DATA RELATING TO AWARDS FOR WATER AND WATER-POWER DIVERSION.

[*Presented December 8, 1909.*]

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At the convention of this Association held in Springfield, September 12, 1907, a resolution was passed "that a committee of five be appointed by the president to collect data relating to awards that have been made for damages resulting from the diversion of water; also to consider the practicability of joint action with the National Cotton Manufacturers' Association, or other organizations of mill owners, relating to the formulation of standard rules of computing or assessing damages for the diversion of water."

ORGANIZATION OF COMMITTEE.

Pursuant to this resolution, the president appointed the following committee:

Charles T. Main, Boston, Mass.; Leonard Metcalf, Boston, Mass.; Richard A. Hale, Lawrence, Mass.; Charles E. Chandler, Norwich, Conn.; William Wheeler, Boston, Mass.

The committee met and organized, with Charles T. Main as chairman and Leonard Metcalf as secretary.

After a careful consideration of the duties of the committee in their broader aspect, the committee decided to include in its search for statistical data relating to the diversion of water or water

power, not only awards which had been made therefor by different tribunals, but also such records of sales of the right to divert power as it might be able to learn of.

METHOD OF OBTAINING DATA.

A printed circular, shown in Appendix C, was sent out to all members of the Association, and to many water-works superintendents and engineers in different parts of the country. This circular was followed by several hundred personal letters addressed by the secretary to water-works men and engineers in different parts of the country and in Canada, who it was hoped might contribute data. Subsequently, several hundred letters were sent out as second and third requests for information, and brief verbal reports of progress were made by the committee at the annual conventions held in Atlantic City and New York City, in 1908 and 1909 respectively.

DIFFICULTY OF OBTAINING INFORMATION.

The committee recognized the difficulty of its task, for data of this sort are soon buried in the files of the interested parties, or their lawyers or experts, and the assembling of the information asked for made a serious demand upon the time of the men addressed. Moreover, in many cases it was recognized that publicity would neither be desirable nor permitted. In all such instances the committee has urged that the information be given in outline, so that the basic facts might be known, without giving the names or the details in such form that the location could be recognized.

It is also perhaps worthy of note that litigation over such cases has been limited almost wholly to the Atlantic or Eastern states, and that little if any information could, therefore, be obtained from other parts of the country.

VALUE OF DATA, AND ACKNOWLEDGMENTS.

It is not for your committee to comment upon the value of the statistics obtained, but it does owe a word of appreciation and

recognition to the public-spirited men who have been willing to devote sufficient of their time to furnish the data which have actually been assembled. Your committee recognizes that data of this sort cannot be directly applied elsewhere, and that each new case must of necessity be judged upon its own merits. Nevertheless, it is hoped that the statistics accumulated are given in sufficient detail to serve as an approximate guide or aid in forming the judgment of those who have questions of this sort to pass upon, incident to the acquiring of additional water supplies or water rights of one kind or another.

SCOPE OF INQUIRY.

While a considerable amount of data, which it is still hoped may be contributed hereto as discussion, has not yet been received, your committee has thought it wiser to present its final report at the present time rather than to postpone its presentation until a later date; but any material which may be presented in the discussion of this report will be incorporated in its final publication in the JOURNAL of the Association.

The scope of the inquiry is indicated by the form of circular sent out, which is shown in Appendix C.

In order to make this report as concise as possible, in tabulating the replies received the questions have been omitted, except in so far as was necessary to make the replies intelligible. The wording of the replies received has been preserved as far as possible, and all of the essential data submitted have been included.

In the fundamental data which follow but one series of facts stated is the work of the committee, — the computation of the unit basis of award or agreed selling price; that is, the amount thereof "per square mile per foot of fall," or "per million gallons daily per foot of fall."

UNIT BASIS OF COMPARISON ADOPTED.

Why, it may be asked here, did your committee select the unit basis adopted for comparison of the information contained in these circulars?

Direct comparison was impossible for obvious reasons. A comparison of the amount of the awards or the prices agreed upon

could not be compared upon a horse-power basis without involving questions as to the character of the use, the hours of use (whether for 24-hour power, 10-hour power, or any other period), and without the exercise of judgment by the committee or of the experts employed upon the different sides of the case.

For this reason it seemed wiser to your committee to adopt as a standard unit of comparison in these cases the amount "($) per square mile per foot of fall," or "($) per million gallons daily per foot of fall." These standards are relatively fixed and easy of determination, for there is usually substantial agreement by the experts as to the extent of the watershed involved and the actual available fall. It is true that in discussing data based upon this standard the variation in yield from watersheds in different parts of the country must be clearly borne in mind. On the other hand, this variation within the limits of the data submitted is slight as compared with the difference in judgment which would have been found had the horse-power basis been adopted. Attention is also called to the fact that the figures discussed relate primarily to the payments for the water-power taken, without allowance for interest upon the award from the date of diversion to the date of award, and without allowance for such items as large adjacent areas of land, mills, tenements, or other buildings, and plant contained therein.

In figuring the amount of award, or price paid per square mile per foot of fall, the watershed actually diverted is used and not the total amount of watershed above the privilege (unless the entire amount above the privilege was diverted), and the available fall in feet (rather than the fall actually developed or utilized). Similarly, in figuring the unit "($) per million gallons daily per foot of fall," the amount of water the right to divert which was taken was assumed rather than the actual amount of the diversion at the time of the taking. And the result is given usually to three significant figures only, the limit of accuracy.

FUNDAMENTAL STATISTICS SUBMITTED.

The fundamental statistics received are submitted in Appendix B of this report.

SUMMARIZED RESULTS.

For the purpose of more readily making comparison in any desired analysis of the fundamental data, the results submitted in Appendix B have been summarized in the brief form submitted in Appendix A. This form (Appendix A) includes the statements of the total watershed above the damaged property, the amount of watershed from which water was actually diverted, the available fall, the unit prices paid, either per square mile per foot of fall or per million gallons daily per foot of fall, and a few significant remarks, — all grouped into four broad classes as follows:

Developed Privileges:

(*a*) Value on Award.

(*b*) Value on Agreement.

Undeveloped or Unused Privileges:

(*c*) Value on Award.

(*d*) Value on Agreement.

Cases in which the prices paid (either on award or agreement) cover not only the power privilege itself, but the taking of large areas of land, mill properties and plants, tenements, etc., have been enclosed in the columns of unit paid by parentheses, and have been omitted from the averages made of those columns.

The general range covered by the data accumulated is shown in the following table:

TABLE I.

	Number of Cases.	Value per Square Mile of Watershed per Foot of Fall.		
		Max.	Min.	Average
Developed privileges:				
a. By award	125	$366.10	$2.45	$76.85
b. By agreement	60	181.20	2.80	52.85
Combined (*a* and *b*)	185	366.10	2.45	**69.07**
Undeveloped, unused, or abandoned privileges:				
c. By award	10	15.72	0.20	7.13
d. By agreement	11	25.60	1.04	8.15
Combined (*c* and *d*)	21	25.60	0.20	**7.66**

The number of awards per million gallons of water diverted are so few that the reader is referred directly to Appendix A for them.

INTERPRETATION OF RESULTS.

It hardly seems necessary to allude to the fact, which must be patent to any student of this subject, that none of the results submitted can be applied directly to new cases, for the reason that no two cases are identical or even thoroughly similar.

Your committee, therefore, desires to place itself on record in urging caution in the application of the information submitted, and calls attention to a few of the considerations which must be clearly borne in mind in making comparison of conditions.

Among these conditions may be mentioned the method by which the price paid for the water or power diverted was determined, whether by agreement or by legal procedure; the knowledge and proficiency of the interested parties, or those called to their assistance; the market value of the privilege affected; the cost of development; the character of the privilege, if developed; the degree of development; the character of the use of the development; the character of the particular industry and of the industries of the community in which the privilege is located; the labor conditions; the location of the privilege in reference to railroads, water, or other transportation facilities; the yield of the streams in amount, distribution, and constancy, and the storage facilities upon them.

And, finally, in comparing the prices paid, by award or agreement, let the fact not be lost sight of that litigation is expensive, and that while awards may seem high in some cases, the actual financial return to the injured parties after deduction of the cost of litigation may be less even than could have been obtained by agreement without legal procedure. Even agreement implies compromise, and considerable sums of money are often paid by agreement to avoid the expense of litigation.

APPROXIMATE POWER DERIVABLE FROM NEW ENGLAND WATERSHEDS.

Your committee recognizes the danger of laying down approximate rules for determining the amount of power to be derived from watersheds with privileges of known fall in New England.

The subject is one requiring the judgment of one well versed in such matters, for different conditions, such as the character of the watershed, its location and elevation, the amount and control of the storage upon it, etc., will materially affect not only the amount, but, more important, perhaps, the distribution and constancy of the power to be derived from these watersheds.

For purposes of approximation, and for the benefit of those who may wish to form some general idea of the relation between the yield or flow of streams in this vicinity* and the available 24-hour power to be derived from them, the following approximate general rule may be of service:

A yearly average of approximately one tenth of one horse-power per square mile of tributary watershed per foot of fall (which corresponds to a maximum 24-hour flow or development of water of about 1.4 cubic feet per second per square mile of watershed and a maximum available 24-hour net power of 0.12 horse-power per foot of fall per square mile of watershed) *may generally be obtained economically*, and a correspondingly greater rate of output if the power be used for less than twenty-four hours per day, and sufficient pondage be available to make such concentrated use of the water possible.

Example: Thus a watershed of 45 square miles area tributary to a dam site having an available fall of 25 feet may be relied upon to develop an approximate average 24-hour power of $0.1 \times 45 \times 25 = 112.5$ horse-power.

The yield or flow of water from the Sudbury, Nashua, and Croton River watersheds has been carefully observed for a long period of years and has shown the following average results in cubic feet of water flowing per second from each square mile of watershed, arranging the average monthly records of each year in the order of the dryness of those months instead of in the calender order of the months, and averaging these results, obtaining thus the average for a long period of years of the driest month of each year, of the second driest month of each year, the third driest, etc., to the wettest month of each year.

The Sudbury yields are stated for three different periods:

First. The twenty-three-year period from 1875 to 1897, for

* Central, southern, and eastern New England.

TABLE II.

YIELD IN CUBIC FEET PER SECOND PER SQUARE MILE OF WATERSHED.

Month.	SUDBURY RIVER. (75.2 sq. mi.) (1.9% to 6.5% water surface.)			NASHUA RIVER. (118.19 sq. mi.) (2.2 to 7% water surface.)	CROTON RIVER. (360.4 sq. mi.) (4.47% water surface.)	
	23-year period, 1875-1897.	12-year period, 1897-1908.	34-year period, 1875-1908.	12-year period, 1897-1908.	32-year* period, 1868-1899.	41-year period. 1868-1908.
Driest.....	0.192	0.098	0.160	0.385	0.26	0.25
Second driest.....	0.271	0.232	0.256	0.557	0.41	0.44
Third "	0.434	0.431	0.420	0.722	0.55	0.59
Fourth "	0.582	0.614	0.551	0.903	0.74	0.76
Fifth "	0.771	0.730	0.741	1.022	0.93	0.97
Sixth "	1.049	0.871	0.976	1.182	1.20	1.24
Seventh "	1.303	1.048	1.210	1.401	1.41	1.47
Eighth "	1.598	1.719	1.644	1.861	1.74	1.82
Ninth "	2.225	2.314	2.273	2.431	2.18	2.24
Tenth "	2.801	2.761	2.800	2.811	2.73	2.78
Eleventh "	3.565	3.610	3.613	3.705	3.41	3.50
Wettest.....	4.922	4.891	4.939	4.969	4.48	4.64
Average.....	1.643	1.610	1.617	1.829	1.66	1.73

* See John R. Freeman's report upon New York Water Supply, p. 240.

the reason that the records of this period are believed to be more precise than the later records, as the water surfaces of the reservoirs upon this watershed were largely increased at this time, and as since March, 1898, an increasing quantity of water has been diverted from the Nashua River through the Sudbury basin, involving the measuring in and measuring out of this flow in addition to observations upon the gain and loss in storage in the reservoirs upon the Sudbury watershed.

Second. The twelve-year period from 1897 to 1908, the period during which observations have also been made upon the Nashua River.

Third. The entire thirty-four-year period from 1875 to 1908.

Attention is called to the fact that the Sudbury River yield records do not give the actual run-off of the river (which would

include the effect of storage in the wet season and draft from storage in the dry season from the tributary reservoirs and streams, as well as the loss by evaporation of water from them), but the natural flow of the watershed *without* storage, so nearly as this flow can be measured and adjusted for the change in volume of stored water, but without taking into account the actual loss of water by evaporation from the water surfaces of the existing reservoirs and streams upon this watershed. It may be said that this method of figuring the yield is common in water works or supply cases, as is the case also in the Nashua and Croton records, but upon streams utilized chiefly for power production purposes the effect of storage as well as the loss by evaporation is included in the yield or run-off measurements and records.

If we assume, further, according to the probable concensus of opinion of engineers,—

First, a wheel development at the water-power privilege being investigated, corresponding to the yield of the tributary watershed in the seventh month, arranged in order of dryness;

Second, collection of water or yield upon the tributary watershed as shown in the tabulations above, which do not cover the effect of large storage basins, to equalize the flow of the wet and the dry season;

Third, 75 per cent. efficiency in the use of water in the development of power,

the resulting net 24-hour power to be developed per square mile of tributary watershed per foot of fall will be as follows:

TABLE III.

RESULTING AVAILABLE NET TWENTY-FOUR-HOUR POWER PER SQUARE MILE PER FOOT FALL FROM ABOVE ASSUMPTIONS, UPON BASIS OF THE YIELDS OF THE FOLLOWING RIVERS.

Month.	SUDBURY.			NASHUA.	CROTON.	
	23 years, 1875-1897. Horse-Power.	12 years, 1897-1908. Horse-Power.	34 years, 1875-1908. Horse-Power.	12 years, 1897-1908. Horse-Power.	32 years, 1868-1899. Horse-Power.	41 years, 1868-1908. Horse-Power.
Driest.....	0.0164	0.0083	0.0136	0.0328	0.0221	0.0213
Second driest.....	0.0231	0.0197	0.0218	0.0474	0.0349	0.0374
Third „	0.0369	0.0367	0.0357	0.0614	0.0468	0.0502
Fourth „	0.0495	0.0523	0.0469	0.0768	0.0640	0.0647
Fifth „	0.0656	0.0621	0.0630	0.0870	0.0792	0.0825
Sixth „	0.0892	0.0741	0.0830	0.1006	0.1021	0.1055
Seventh „	0.1108	0.0892	0.1030	0.1193	0.1200	0.1251
Eighth „	0.1108	0.0892	0.1030	0.1193	0.1200	0.1251
Ninth „	0.1108	0.0892	0.1030	0.1193	0.1200	0.1251
Tenth „	0.1108	0.0892	0.1030	0.1193	0.1200	0.1251
Eleventh „	0.1108	0.0892	0.1030	0.1193	0.1200	0.1251
Wettest „	0.1108	0.0892	0.1030	0.1193	0.1200	0.1251
Average	0.0788	0.0657	0.0735	0.0935	0.0891	0.0927
„ minimum	0.0164	0.0083	0.0136	0.0328	0.0221	0.0213

Example: The method of computation is shown by the calculations of the figure for the driest month on the Croton basis, as follows:

1 (sq. mi.) × 0.26 (c.f.s. per square mile) × 62.4 (lb.) × 1 (foot fall) × 0.75 (efficiency) ÷ 550 (ft. lb. per second) = 0.0221 h.p.

The actual wheel development or installation, which usually materially exceeds the *average* power obtainable, varies with the available water and the portion of the day into which its flow is concentrated, or during which it is used, and some other considerations or factors. In 24-hour power developments in this region the wheel development is perhaps generally designed to utilize from 1 to 1.4 cubic feet of water per second per square mile of tributary watershed, and even more in special cases; in 10-hour power developments an examination of a large number of actual mill installations upon New England streams has shown a develop-

ment to utilize approximately 1.4 cubic feet of water per second per square mile of tributary watershed, corresponding to the yield of the sixth or seventh month, arranged in the order of their dryness, of an average year; or more in special cases, depending upon the amount of available pondage adjacent to the water power plant or privilege, the character of the industry, etc.

The relation between the amount of water flowing and the horse-power obtainable from it is indicated by the following table:

1 cubic foot of water per second per square mile per foot of fall at 75% efficiency =

1 c.f.p.s	× 62.43 lb.	×	$\frac{1 \text{ ft. fall}}{550}$	×	$\frac{75}{100}$ efficiency	= 0.08513 h. p.
1.25 c.f.p.s.	,,		,,		,,	= 0.1064 ,,
1.4 c.f.p.s.	,,		,,		,,	= 0.1192 ,,
1.5 c.f.p.s.	,,		,,		,,	= 0.1277 ,,

From Table III it appears that, for purposes of general approximation, we may assume that in New England watersheds *without* a material amount of storage and with a development up to the yield of the seventh month of an average year, arranged in the order of the dryness of those months, there can be obtained an *average* of approximately 0.09 horse-power (24-hour power) per square mile of tributary watershed per foot of fall, but the minimum power under such conditions may fall to one third or less of this amount. *With* storage the above-stated available power (0.09 horse-power) would be appreciably increased, the amount of this increase depending upon the volume and control of this storage.

In the light of all of these facts, it is perhaps safe to say, as previously stated, *that for purposes of rough approximation for* * *New England watersheds with some storage, there can be developed one tenth of one horse-power (24-hour power) per square mile of watershed per foot of fall*, but it must be clearly borne in mind, as stated, that local conditions, character of watershed, location and elevation, storage facilities and control, cost, and character of development and industry to be served will modify this figure materially.

UNITS.

Nomenclature.

g.p.d. = gallons per day of 24 hours.
g.p.m. = gallons per minute.
c.f.p.s. = cubic feet per second.

* Central, southern, and eastern New England.

Flow.

1 c.f.p.s. = 646 317 g.p.d. = 0.991736 inch-acre-hour.
1 000 000 g.p.d. = 1.54723 c.f.p.s. = 1.53444 inch-acre hours.
1 inch-acre-hour = 1.00833 c.f.p.s. = 651 703 g.p.d.
1 U. S. g.p.m. = 1440 g.p.d. = 0.002228 c.f.p.s.

Time.

10	hours =	600	minutes =	36 000	seconds.
24	„ =	1 440	„ =	86 400	„
28	days =	40 320	„ =	2 419 200	„
29	„ =	41 760	„ =	2 505 600	„
30	„ =	43 200	„ =	2 592 000	„
$30\frac{5}{12}$	„ =	43 500	„ =	2 628 000	„
31	„ =	44 640	„ =	2 678 400	„
365	„ =	525 600	„ =	31 536 000	„
365.25	„ =	525 960	„ =	31 557 600	„
366	„ =	527 040	„ =	31 622 400	„

Volumes.

1 cu. ft. = 7.481 U. S. gal.
1 U. S. gal. = 231 cu. in. = 0.1337 cu. ft.

Weight of Water.

1 cu. ft. = 62.43 lb.
1 U. S. gal. = 8.345 „

Power.

1 h. p. = 33 000 ft. lb. per minute = 550 ft. lb. per second.
1 h. p. = 8.805 c.f.p.s. per foot fall = 5.694 m.g.d. if efficiency = 100%
1 „ = 11.012 „ „ „ „ = 7.118 „ „ „ = 80%
1 „ = 11.746 „ „ „ „ = 7.594 „ „ „ = 75%
1 c.f.p.s. per foot fall = 0.11350 gross h. p. at 100% efficiency.
= 0.09081 net „ „ 80% „
= 0.08513 „ „ „ 75% „
1 net h. p. = 11 c.f.p.s. per foot fall at 80.09% efficiency.
1 „ „ = 12 „ „ „ „ „ 73.42% „
1 U. S. g.p.m. per foot fall = 0.0002539 gross h. p. at 100% efficiency.
= 0.0002023 net „ „ 80% „
= 0.0001897 „ „ „ 75% „
1 000 000 U. S. g.p.d. per foot fall = 0.1756 gross h. p. at 100% efficiency.
= 0.1405 net „ „ 80% „
= 0.1317 „ „ „ 75% „

Run-Off.

1 in.	per	square	mile	per	hour		=	645.33	c.f.p.s.	=	417 079 832 g.p.d.
1	„	„	„	„	24	hours	=	26.889	„	=	17 378 743 „
1	„	„	„	„	28	days	=	0.96032	„	=	620 669 „
1	„	„	„	„	29	„	=	0.92720	„	=	599 267 „
1	„	„	„	„	30	„	=	0.89630	„	=	579 291 „
1	„	„	„	„	$30\frac{5}{12}$	„	=	0.88401	„	=	571 356 „
1	„	„	„	„	31	„	=	0.86738	„	=	560 505 „
1	„	„	„	„	365	„	=	0.073668	„	=	47 613 „
1	„	„	„	„	$365\frac{1}{4}$	„	=	0.073618	„	=	47 580 „
1	„	„	„	„	366	„	=	0.073467	„	=	47 483 „

FORMULATION OF STANDARD RULES FOR ASSESSING DAMAGES IMPOSSIBLE.

Your committee has considered carefully, as instructed by the original vote passed by this Association, "the practicability of joint action with the National Cotton Manufacturers' Association, or other organizations of mill owners, relating to the formulation of standard rules of computing or assessing damages for the diversion of water," and has conferred with officials of various associations, and regrets that it must now report the impracticability of such action. The questions involved are so much a matter of law, the outgrowth of centuries of experience, and the nature of the problems to be passed upon is so diverse, and the interests involved are so many and even so antagonistic as to make it absolutely hopeless to attempt to formulate, or even to outline, any standard rules as suggested.

BIBLIOGRAPHY.

To round out this report, it has seemed advantageous to submit a bibliography of articles which have appeared in engineering literature relating to prices paid for water or water-power diversion. With this end in view, your committee have had a search made of the libraries of the American Society of Civil Engineers and the American Society of Mechanical Engineers, which are located in New York City, and some references have been added from the personal files of the members of the committee.

The demands upon the time of the members of your committee in the collection, collation, summarization, and discussion of the

data obtained have already been so heavy as to make it practically impossible for its members to personally read and abstract the references contained in this bibliography. The references are submitted in Appendix D, however, for the use of those whose need may make it advantageous to make more extended personal inquiries into the available literature upon this complex question.

LEGAL QUESTIONS INVOLVED IN THE DIVERSION OF WATER.

The committee felt that it would be advantageous to have presented to you as a sort of introduction to this subject a brief paper on the legal aspects of the diversion of water, the general methods of procedure, riparian ownership, etc., by some competent legal authority. It invited Charles F. Choate, Jr., Esq., a lawyer of highest rank in this city and of large experience, and well versed in cases of this kind, to prepare such a paper, and Mr. Choate kindly consented to do this in spite of the pressing demands of his practice. Your committee considers this Association most fortunate in securing Mr. Choate's coöperation in this direction.

In conclusion, your committee desires to express its appreciation of the friendly interest and coöperation of those who have contributed data for this report.

Respectfully submitted,

CHARLES T. MAIN, *Chairman.*
CHARLES E. CHANDLER.
RICHARD A. HALE.
WILLIAM WHEELER.
LEONARD METCALF, *Secretary.*

APPENDIX A.

SUMMARY OF DEVELOPED PRIVILEGES. **By Award.**

Location.	Watershed. Square Miles.		Available Fall. Feet.	Award (Excluding Interest), etc..		Remarks.
	Total.	Diverted.		Per Square Mile of Watershed per Foot of Fall.	Per Million Gallons Daily per Foot of Fall.	
CONNECTICUT.						
Cheshire, Ten Mile Brook	5.6	1.6	22.	($198.86)	.....	Unusual st'age facilities.
" " " "	5.7	1.6	20.	46.87	.....	
Naugatuck, Straitsville Brook	20.	1.8	35.	2.45	.....	
New London, Briggs' Brook	2.	1.6	51.	(95.60)	.....	Including rights of way.
" " " "	2.4	1.6	....	.....	.....	Special case.
Plainville, Pequabuck River	46.4	7.2	15.1	65.		
Waterbury, Naugatuck River	20.	18.	7.	15.90	.....	
" " "	23.	18.	13.	29.90	.....	
" " "	23.2	18.	7.	9.52	.....	
Wilton	7.	...	7. (?)	.....	.....	Special case.
Windsor, Mill Brook	1.	...	20.	.....	$449.00	200 000 g.p.d.
" " "	1.	...	9.8	.....		
DISTRICT OF COLUMBIA	...	...	....	.....	.....	Special case.
MAINE.						
Waterville, Messalonskee River	204.	204.	13.	6.32	.....	Including small allowance for buildings.
MASSACHUSETTS.						
Charles River, 5 mills	...	...	26.7	.....	185.40	2 m.g.d.
Ayer, Nashua River	302.	118.3	8.	21.20	.....	
Braintree	...	...	....	.....	.....	Special case.
Canton, Beaver Brook	2.7	2.6	20.5	18.80	.....	
Easthampton, Manhan River	60.5	13.	16.	105.70	.....	
Gardner	...	...	....	.....	.....	$106 000 per m.g.d., about 850 000 g.p.d.
Gloucester	...	...	....	.....	.....	$197 000 per m.g.d., about 890 000 g.p.d.
Haverhill, East Meadow River	7.8	7.8	9.	43.00	.....	
" " " "	7.5	7.5	8.	50.00	.....	
Holyoke, Manhan River	27.5	13.	13.5	49.30	.....	
Hopkinton, Whitehall Pond	...	...	....	.....	.....	Special case.

Hudson, Assabet River	64.3	3.4	9.	113.00	.....	
Kingston, Jones River	19.8	4.4	8.	(483.00)	.....	Special case.
Maynard, Assabet River	113.1	3.4	22.2	111.00	.....	
" " "	113.1	3.4	12.0	103.50	.....	
" " "	115.6	3.4	10.8	111.00	.....	
Middleboro, Nemasket River	59.	48.1	10.	12.70	.....	
Northampton, Mill River	13.	7.2	30.	27.60	.....	
" " "	47.	7.2	14.5	145.20	.....	
" West Brook	13.1	7.2	18.5	20.10	.....	
" " "	13.2	7.2	22.5	30.90	.....	
Pepperell, Nashua River	434.1	118.2	19.	49.70	.....	
Southampton, Manhan River	34.7	13.	9.	13.53	.....	
South Deerfield, Mill Pond	39.2	3.7	14.5	43.50	.....	
Springfield, Jabish Brook	...	10.6	123.5	34.30	.....	5 mills.
Stow, Assabet River	77.0	3.4	11.5	87.70	.....	
Waltham and Watertown, Stony Brook	251.4	23.	12.1 4. 4.80 5.80	24.40	.....	4 privileges.
Waltham, Stony Brook	4.1	4.1	8.	51.35		
" " "	23.	23.	16.	(69.29)	.....	Including value for other uses of water.
Westfield, Little River	81.	6.4	8.	54.10		
" " "	76.	6.4	10.	95.60		
" " "	80.	6.4	18.			
Westvale, Assabet River	116.8	3.4	8.8	124.00	.....	
Worcester, Kettle Brook cases	48 to 472.5	3.856	Various.	137.22	.....	45 privileges. 69 mills on Kettle Brook and Blackstone River. Range of awards from $366.10 to $81.80 per sq. mi. per ft. fall.
NEW HAMPSHIRE.						
Manchester, Lake Massabesic	66.	45.	46.	24.20	.....	
Nashua	29.	1.1	25.	89.70	.....	Including interest and collateral items.
NEW YORK.						
Bedford	28.1	...	32.5	70.00		
Brunswick, Quackenkill River	81.	17.5	29.	47.25	.....	Partially developed. Another suit pending.
Fort Plain, North Creek	81.	4.65	19.	57.20	.....	4 owners.
Franklin	...	...	....	.....	.....	Special case.
Lewisboro, Cross River	3.72	3.72	7.8	311.		
" " "	16.5	16.5	11.5	94.70		

SUMMARY OF DEVELOPED PRIVILEGES.

(*Continued.*)

By Award.

Location.	Watershed. Square Miles. Total.	Watershed. Square Miles. Diverted.	Available Fall. Feet.	Award (Excluding Interest), etc. Per Square Mile of Watershed per Foot of Fall.	Award (Excluding Interest), etc. Per Million Gallons Daily per Foot of Fall.	Remarks.
NEW YORK.						
Little Falls	...	...	....	.....	.....	Special case. Data incomplete.
Pittstown, Tomhannock Creek	1.8	1.8	20.	($91.40)	.....	Including some land and houses.
" " "	10.	10.	24.	(70.80)	.....	Including land and houses.
Rochester, Hemlock and Canadice Lakes	202.3	62.4	270.	11.30	$43.50 11.90	22 owners, 21 privileges. First diversion, 9 m.g.d. Second " remaining yield, approx. 20 m.g.d. Second diversion payts. were on agreement.
Schagticoke, Tomhannock Creek	69.	67.	18.	13.70*		
NORTH CAROLINA.						
Durham	120 (?)	...	11.	.....	364.00	1 m.g.d.
PENNSYLVANIA.						
Media	33.	29.9	25.	10.10	173.30	Partially developed, 1.5 m.g.d.
Crum Lynn, Crum Creek	34.9	29.5	13.5	8.50	130.00	
Springfield, Crum Creek	31.9	29.5	10.	33.90	500.00	2 m.g.d.
VERMONT.						
Barre	42.	2.7	8.0	13.90		
"	42.	2.7	12.3	40.80		
"	42.	2.7	14.7	27.70		
"	42.	2.7	22.6	18.00		
Total, excluding figures in parentheses and giving multiplied weight to average figures for several privileges (each owned, perhaps, by several mills)				$9 606.89		
Average (of 125 " Developed Privileges, by Award ")				**$76.85**		

* Two privileges.

SUMMARY OF DEVELOPED PRIVILEGES.

By Agreement.

Location.	Watershed. Square Miles. Total.	Watershed. Square Miles. Diverted.	Available all. Feet.	Price (Excluding Interest), etc. Per Square Mile per Foot of Fall.	Price (Excluding Interest), etc. Per Million Gallons Daily per Foot of Fall.	Remarks.
CONNECTICUT.						
Cheshire, Ten Mile River	73.5	1.6	6.9	$54.40		
" " " "	7.3	1.6	9.8	63.80		
East Lyme, Great Brook	16.5	6.4	9.8	23.90		
" " " "	16.4	6.4	11.7	52.90		
" " " "	10.4	6.4	20.	46.60		
Killingly, Whetstone Brook	14.9	0.4	15.	36.20		
" " "	15.0	0.4	26.	35.70		
Meriden and Wallingford, 6 privileges on Quinnipiac River	92.1	1.6	18.	52.90	.....	6 privileges.
	94.4	1.6	8.			
	96.	1.6	7.1			
	100.4	1.6	5.9			
	106.4	1.6	8.			
	106.5	1.6	6.25			
Montville, Great Brook	6.4	6.4	10.	(108.60)	.....	Includes mill.
Norwich, Yantic River	93.	1.5	71.	47.00		
" Hammer Brook	2.5	1.5	Unknown.	.....	.....	Special case.
" Ice Pond	0.6	0.3	5.	.....	.....	Special case.
Plainfield, Mill Brook	20.	0.9	47.	37.80		
Southington, Ten Mile River	16.6	1.6	5.7	54.80		
Thompson, French River	94.	94.	1.5	53.20		
Wallingford, Quinipiac River	110.5	1.6	6.9	181.20		
Waterbury, Naugatuck River	21.	18.	12.	13.90		
Waterford, Beaver Dam Brook	8.8	0.6	33.	147.00		
" " " "	8.8	0.6	20.	48.40		
MASSACHUSETTS.						
Andover, Merrimac River	....	2.7	30.	14.80		
Billerica, " "	352.	75.2	11.	87.50		

SUMMARY OF DEVELOPED PRIVILEGES.

(*Continued.*)

By Agreement.

Location.	Watershed. Square Miles. Total.	Watershed. Square Miles. Diverted.	Available Fall. Feet.	Price (Excluding Interest), etc. Per Square Mile per Foot of Fall.	Price (Excluding Interest), etc. Per Million Gallons Daily per Foot of Fall.	Remarks.
Clinton, Wachusett Reservoir	113.4	113.4	15.5	$35.20		
,, ,, ,,	118.3	118.3	28.	87.30		
Framingham, Sudbury River	100.0	75.2	26.	67.20		
Groton	428.5	118.3	8.	37.00		
Lancaster and Clinton, Nashua River	128.8	118.2	8.	37.00		
Lawrence, Merrimac River	4 599.	118.2	32.5	22.62	.....	Essex Company.
,, ,, ,,	4 599.	75.2	32.	10.90		
Lowell, Concord River	370.	75.2	24.8	70.90	.....	8 Mills on one privilege.
,, ,, ,,	375.	75.2	8.	28.80		
,, ,, ,,	380.	75.2	11.3	41.10		
,, Merrimac ,,	4 085.	118.2	39.	25.15	.....	Locks and Canals [Company.
Middleboro, Assawompsett Pond	59.	12.8	13.5	37.50		
Oakdale, Nashua River	94.8	94.8	27.	35.15		
,, Quinepoxet River	53.8	53.8	22.8	} 24.30		
,, ,, ,,	54.2	54.2	16.8	}		
Springfield, Chicopee River	*	8.1	33.	21.10		
,, ,, ,,	*	8.1	28.	19.60		
,, ,, ,,	*	8.1	33.	7.20		
,, ,, ,,	*	8.1	43.	2.80		
,, ,, ,,	*	8.1	13 5	17.30		
Wellesley, Charles River	.....	....	.....	92.14		
West Boylston, Nashua River	98.3	98.3	11.	20.70		
,, ,, ,,	98.3	98.3	11.	20.70		
,, ,, ,,	98.9	98.9	18.4	29.10		
MARYLAND.						
Baltimore, Yantic River	280.	....	10.	.....	$100.00	Up to 150 m.g.d.

* Several hundred square miles.

NEW HAMPSHIRE.						
Ashland, Winnepesaukee Lake, 2 mills	56.7	56.7	29.	(6.08)	.....	Including bldgs. In 1888.
Brist l,	91.	91.	46(?)	(3.58)	.....	In 1884.
Nashua, Nashua River	522.0	118.2	35.3	33.60	.....	3 privileges.
	506.1	118.2	11.0			
	527.3	118.2	22.3	58.00		
Tilton, Laconia, and Guilford, on Lake Winnepesaukee	366.	366.	16.	6.75	.....	In 1889.
	428.	428.	12.			
Wolfboro	24.	24.	18.	13.87	.....	In 1889.
NEW YORK.						
Brunswick, Quackenkill River	25.3	17.5	3.	52.38		
Troy, Poestenkill Creek	96.	17.5	12.	23.80		
PENNSYLVANIA.						
Bradford	104.	14.	9.5	(112.80)	.....	Including mill. 1.5 m.g.d.
Springfield, Crum Creek	25.	25.	10.	20.00		
RHODE ISLAND.						
Woonsocket, Blackstone River	472.	7.9	174.9	137.00	.....	Average. 6 privileges.

Total, exclusive of amounts shown in parenthesis, *giving multiplied weight to average records* for several privileges, each owned, perhaps, by several mills $3 171.26

Average (of 60 "Developed Privileges by Agreement"), $52.85

Average of 185 "Developed Privileges by Award and by Agreement" $69.07

SUMMARY OF UNDEVELOPED, ABANDONED, OR UNUSED PRIVILEGES.

By Award.

Location.	Watershed. Square Miles. Total.	Watershed. Square Miles. Diverted.	Available. Fall. Feet.	Price (Excluding Interest), etc. Per Square Mile per Foot of Fall.	Price (Excluding Interest), etc. Per Million Gallons Daily per Foot Fall.	Remarks.
CONNECTICUT.						
Killingly, Whetstone Brook	14.8	0.4	12.	$12.80		
Putnam, Little River	40.8	...	33.	.....	$136.00	500 000 g.p.d.
MASSACHUSETTS.						
Avon, Porter's Spring	...	...	.....	.....	.....	$52 600 per m.g.d., about 90 000 g.p.d.
Gloucester, Lily Pond	...	...	.....	.....	.....	$25 600 per m.g.d., about 780 000 g.p.d.
Waltham, Stony Brook	21.5	21.5	29.6	$15.72	.....	Practically an abandoned privilege.
Westfield, Little River	21.	6.4	10.	6.98		
NEW HAMPSHIRE.						
Nashua, Nashua River	528.	118.2	.....	.....	.....	Special damage.
NEW YORK.						
Ithaca, Taughannock River	67.	67.	543.	2.21		
Rome, Fish Creek	135.	..	273.	0.20		
Schaghticoke, Tomhannock Creek	69.	67.	18.	*	.....	Unused privilege.
" " "	75.	67.	150.	2.19		
" " "	78.	67.	40.	5.97		
" " "	80.	67.	8.	2.24		
PENNSYLVANIA.						
Springfield, Crum Creek	33.7	21.9	11.	11.20	123.00	Abandoned privilege.
VERMONT.						
Barre	42.	2.7	28.3	11.80		
Average (of 10 "Undeveloped Privileges by Award")				**$7.13**		

* Included with No. 166.

CONNECTICUT.						
Cheshire, Ten Mile River	6.3	1.6	16.	5.86		
East Lyme, Great Brook	16.4	6.4	9.5	19.60		
" " " "	16.4	6.4	9.1	25.60		
" " " "	14.2	6.4	11.	8.50		
MAINE.						
Tributary to Kennebec	200.	200.	38.	1.71		
" " "	200.	200.	48.	2.50		
NEW HAMPSHIRE	3 000.		20.	4.70		
NEW YORK.						
Brunswick, Quackenkill River	91.3	17.5	55.1	6.23		
" " "	91.3	17.5	10.6	5.40		
" " "	18.1	17.5	74.	1.04		
PENNSYLVANIA.						
Springfield, Crum Creek	33.7	29.5	14.	8.48	125.00	Abandoned privilege.

Average (of 11 "Undeveloped Privileges by Agreement") . . . $8.15

Average (of 21 "Undeveloped Privileges by Award and by Agreement"), $7.66

APPENDIX B.

FUNDAMENTAL DATA RECEIVED BY COMMITTEE.

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1 Connecticut, Cheshire, New Haven County, 1909.
New Haven Water Company and Cheshire Brass Company.
DEVELOPED WATER PRIVILEGE ON TEN MILE BROOK.
Authority: C. E. Chandler, Norwich, Conn., and A. B. Hill, New Haven.
BY AWARD, $7 000.

Watershed above privilege: 5.6 square miles.
Watershed taken: 1.6 square miles.
Fall: 22 feet.
Fall developed: 22 feet.
12 hour power.
Character of development: dams, canals, etc. Product of mill is brass plate.
Character of watershed: partly mountainous and partly glacial drift.
Coal: $4.50 per ton.
A small amount of water is used for other purposes than power.
One 50 HP. wheel installed.
150 HP. of steam.
100 to 200 HP. required to run mill.
150 HP. supplementary power necessary.
Area of mill pond, 4 000 square feet.
Working depth of mill pond, 1 foot.
1 storage reservoir upon watershed of 1 800 000 cubic feet.
Full control.
Controlling factor in the award: market value of the property.
The existence of a relatively large storage reservoir in full control of the mill owner made the diverted water theoretically unusually valuable. Mill owner claimed an underground drainage area much greater than surface drainage area. Brass Company's engineers claimed average diverted power 19½ HP. Water Company's engineer claimed 7 HP. Brass Company's engineer claimed damage $23 450. Water Company's engineer claimed not over $5 000.

$198.86 PER SQUARE MILE PER FOOT OF FALL.

2 Connecticut, Cheshire, New Haven County, 1909.
New Haven Water Company and John O. Shares.
DEVELOPED WATER PRIVILEGE ON TEN MILE BROOK.
Authority: C. E. Chandler, Norwich, Conn., and A. B. Hill, New Haven, Conn.
BY AWARD, $1 500.

Watershed above privilege: 5.7 square miles.
Watershed taken: 1.6 square miles.
Fall: 20 feet.
Fall developed: 19.4 feet.
Power not in use at time of trial but had been in use ten hours per day.
Character of development: dam, races, etc., and shop for making hardware.
Character of watershed: partly mountainous and partly glacial drift.
No steam used. Water for power only.
Number of wheels installed: one 35 HP.
Power required to run mill: variable.
Area of mill pond: ¼ of an acre.
Storage reservoirs upon watershed: one, containing 1 800 000 cubic feet.
Controlling factors in the award: relative market value of the property before and after taking.
Practically the ownership of this power was identical with that of the Cheshire Brass Mill, and this owner had the benefit of the storage and pondage above. Technically the ownership was separate and this owner had no rights therein. John O. Shares claimed his intention was to use it in connection with the Cheshire Brass Mill by the aid of electricity, and his engineer claimed about $21 000 damages. The Water Company's engineers claimed that the damage did not exceed $1 300 to $1 500 for practical reasons as to market value and theoretical reasons as to storage and pondage.

$46.87 PER SQUARE MILE PER FOOT OF FALL.

3 Connecticut, Cheshire, 1908.
George C. McKenzie *v.* New Haven Water Company.
DEVELOPED WATER PRIVILEGE ON TEN MILE RIVER.
Authority: A. B. Hill, New Haven, Conn.
BY AGREEMENT, $600.

Grist and saw mill.
Watershed taken: 1.6 out of 73.5 square miles.
Fall used: 6.9 feet.
10 hour power.

Character of watershed: broad, sandy valley between high, rocky hills.
No auxiliary power. Water for power only.
4 wheels installed, 8.4, 5.6, 12.5, and 48.2 HP.
Mill pond: 500 000 cubic feet.
Usable power diverted (at 75 per cent. efficiency): 0.37 HP.
$54.40 PER SQUARE MILE PER FOOT OF FALL.

4 Connecticut, Cheshire, 1908.
Jane E. Warner *v.* New Haven Water Company.
UNDEVELOPED WATER PRIVILEGE ON TEN MILE RIVER.
Authority: A. B. Hill, New Haven, Conn.
BY AGREEMENT, $150.
Cider and saw mill.
Watershed taken: 1.6 out of 6.3 square miles.
Diversion: 0.69 HP. (at 75 per cent. efficiency).
Fall used: 16 feet.
Character of watershed: narrow valley with steep side slopes.
One 10 HP. wheel installed. No auxiliary power.
Water for power only. No pondage.
$5.86 PER SQUARE MILE PER FOOT OF FALL.

5 Connecticut, Cheshire, 1908.
Joseph P. Moss *v.* New Haven Water Company.
DEVELOPED WATER PRIVILEGE ON TEN MILE RIVER.
Authority: A. B. Hill, New Haven, Conn.
BY AGREEMENT, $1 000 (exclusive of interest).
Saw, grist, and wood turning mill.
Watershed taken: 1.6 out of 7.3 square miles.
Fall used: 9.8 feet.
Character of watershed: narrow valley with steep side slopes.
2 wheels, 20 HP. each. No auxiliary power. Water for power only.
Pondage: 300 000 cubic feet.
Usable power diverted (at 75 per cent. efficiency): 3.02 H.P. Power used about one-half time only.
$63.80 PER SQUARE MILE PER FOOT OF FALL.

6 Connecticut, East Lyme, 1901.
Fred G. Hall *v.* New London.
DEVELOPED PRIVILEGE ON GREAT BROOK.
Authority: W. H. Richards, New London, and C. E. Chandler, Norwich, Conn.

BY AGREEMENT, $1 500.
Watershed diverted: 6.44 square miles out of 16.5 square miles.
Theoretical fall: 9.75 feet.
Turning mill.
Watershed: rolling and hilly.
Approximate area of mill pond: 2 acres.
$23.90 PER SQUARE MILE PER FOOT OF FALL.

7 Connecticut, East Lyme, 1901.
Comstock Heirs *v.* City of New London.
UNDEVELOPED PRIVILEGE ON GREAT BROOK.
Authority: W. H. Richards, New London, and C. E. Chandler, Norwich, Conn.
BY AGREEMENT, $1 200.
Watershed diverted: 6.44 square miles out of 16.4 square miles.
Theoretical fall: 9.5 feet.
Watershed: rolling and hilly.
$19.60 PER SQUARE MILE PER FOOT OF FALL.

8 Connecticut, East Lyme, 1901.
Luce Bros. *v.* City of New London.
UNDEVELOPED PRIVILEGE ON GREAT BROOK.
Authority: W. H. Richards, New London, and C. E. Chandler, Norwich, Conn.
BY AGREEMENT, $1 500.
Watershed diverted: 6.44 square miles out of 16.4 square miles.
Theoretical fall: 9.1 feet.
Watershed: rolling and hilly.
Award includes mill site, etc.
$25.60 PER SQUARE MILE PER FOOT OF FALL.

9 Connecticut, East Lyme, 1908.
William G. Sharpe *v.* City of New London.
UNDEVELOPED PRIVILEGE ON GREAT BROOK.
Authority: W. H. Richards, New London, and C. E. Chandler, Norwich, Conn.
BY AGREEMENT, $600.
Watershed diverted: 6.44 square miles out of 14.2 square miles.
Theoretical fall: 11 feet.
Watershed: rolling.
$8.50 PER SQUARE MILE PER FOOT OF FALL.

10 Connecticut, East Lyme, 1901.
Albert R. Darrow *v.* City of New London.
DEVELOPED PRIVILEGE (NOT IN USE) ON GREAT BROOK.
Authority: W. H. Richards, New London, and C. E. Chandler, Norwich, Conn.
BY AGREEMENT, $4 000.
Watershed diverted: 6.44 square miles out of 16.36 square miles.
Theoretical fall: 11.75 feet.
Watershed: rolling and hilly.
Area of mill pond: about 3 or 4 acres.
One small storage reservoir upon watershed.
$52.90 PER SQUARE MILE PER FOOT OF FALL.

11 Connecticut, East Lyme, 1901.
George Lattimer *v.* City of New London.
DEVELOPED PRIVILEGE ON GREAT BROOK.
Authority: W. H. Richards, New London, and C. E. Chandler, Norwich, Conn.
BY AGREEMENT, $6 000.
Watershed diverted: 6.44 out of 10.44 square miles.
Theoretical fall: about 20 feet.
Watershed: rolling and hilly.
Grist mill.
Area of mill pond: less than 1 acre.
$46.60 PER SQUARE MILE PER FOOT OF FALL.

12 Connecticut, Killingly, 1886.
Sabin L. Sayles *v.* Crystal Water Company of Danielson.
DEVELOPED PRIVILEGE ON WHETSTONE BROOK.
Authority: William Wheeler, Boston, Mass.
BY SALE OR AGREEMENT, $234.
Watershed taken: 0.43 square miles out of 14.95 square miles.
Fall: about 15 feet.
10 hour power.
Character of development: woolen mill.
Character of watershed: wood land and pasture.
Steam is used for manufacturing or other purposes.
Approximate area of mill pond: very small.
Storage reservoirs of relatively small capacity upon the watershed.
Character of control: dam and sluice gates.
Award did not include any allowances other than for the water or water power.
$36.20 PER SQUARE MILE PER FOOT OF FALL.

13 Connecticut, Killingly, 1886.

Sabin L. Sayles (Hopkins, Lessee) *v.* Crystal Water Company of Danielson.

DEVELOPED MILL PRIVILEGE ON WHETSTONE BROOK.

Authority: William Wheeler, Boston, Mass.

BY SALE OR AGREEMENT, $400.

Watershed taken: 0.43 square miles out of 15 square miles.
Fall: about 26 feet.
10 hour power.
Character of development: woolen mill.
Character of watershed: woodland and pasture.
Steam is used for manufacturing or other purposes.
Approximate area of mill pond: small.
Relatively small storage areas upon watershed.
Character of control: dam with sluice gates.
Award did not include any allowances other than for the water or water power.

$35.70 PER SQUARE MILE PER FOOT OF FALL.

14 Connecticut, Killingly, 1888.

F. P. Warren *v.* Crystal Water Company of Danielson.

DISMANTLED AND ABANDONED WATER PRIVILEGE ON WHETSTONE BROOK.

Authority: William Wheeler, Boston, Mass.

BY SALE OR AGREEMENT, $66.

Watershed taken: 0.43 square miles out of 14.75 square miles.
Fall: 12 feet.
Character of watershed: woodland and pasture.
Controlling factors in award: 12 feet of fall (dismantled) at $5.50 per foot.
In addition to the stated sum of $66, the sum of $234 was paid for land and to reimburse the seller for estimated cost of building a cattle-pass.

$12.80 PER SQUARE MILE PER FOOT OF FALL.

15 Connecticut, Meriden and Wallingford, 1908.

Meriden Cutlery Company, Jennings & Griffin, The Charles Parker Company, C. I. Yale Manufacturing Company, International Silver Company, R. Wallace & Sons Manufacturing Company *v.* New Haven Water Company.

DEVELOPED PRIVILEGE ON QUINNIPIAC RIVER.

Authority: A. B. Hill, New Haven, Conn.

BY AGREEMENT, $4 500 for six mills. Distribution unknown.

Watersheds above privileges: 92.1, 94.4, 96.0, 100.4, 106.4, and 106.5 square miles respectively.

Watershed taken: 1.6 square miles.

Fall used: 18, 8, 7.1, 5.9, 8, and 6.25 feet respectively. Total, 53.25 feet.

10 hour power.

Character of water shed: broad, sandy valley between high, rocky hills.

Water used for other purposes than power: no, yes, no, yes, no, no.

Number of wheels installed: 1, 2, 3, 1, 2, 2, respectively.

Power of wheels: 152, (90 and 65), (75, 75, and 50), 96, (100 and 100), (47 and 47).

Amount of steam or electricity necessary: none, 165 HP., 100 HP., 60 HP., 60 HP., 450 HP.

Working capacity of mill pond: 5 200 000, 350 000, 75 000, 100 000, 8 750 000, 260 000 cubic feet.

Usable power diverted (75 per cent. efficiency): 0.6 HP., 0.93 HP., 1.32 HP., 0.53 HP., 0.64 HP., 0.32 HP.

Small amount of water used for mill purposes by Jennings & Griffin, also by C. I. Yale Manufacturing Company.

Power used for (1) cutlery; (2) mechanic tools; (3) wood working; (4) edged tools, hardware, and spoons; (5 and 6) silverware.

$52.90 PER SQUARE MILE PER FOOT OF FALL.

16 Connecticut, Montville, 1901.

Joseph M. Beckwith *v.* City of New London.

DEVELOPED PRIVILEGE ON GREAT BROOK.

Authority: W. H. Richards, New London, and C. E. Chandler, Norwich, Conn.

BY AGREEMENT, $7 000.

Watershed diverted: 6.44 out of 6.44 square miles.

Saw mill (small).

Theoretical fall: about 10 feet.

Watershed: hilly.

Approximate area of mill pond: about 2 acres.

Allowance included mill.

$108.60 PER SQUARE MILE PER FOOT OF FALL, INCLUDING MILL.

17 Connecticut, Naugatuck, New Haven County, about 1890.

The Naugatuck Water Company and the Connecticut Rubber Company.

DEVELOPED WATER PRIVILEGE ON STRAITSVILLE BROOK.

Authority: C. E. Chandler, Norwich, Conn.

BY AWARD, $150.

Watershed above privilege: 20 square miles,
Watershed diverted: 1.75 square miles.
Fall taken: 35 feet.
Fall used: 20 feet.
Character of development: consisted of a dam, a water wheel, and a tailrace. Mill in which rubber had been manufactured had been burned.
Character of watershed: rather steep.
Water has been used for other purposes than power.
One wheel installed, 25 HP.
To improve privilege, dam must be raised and tailrace deepened; cost not estimated.
Estimated area of mill pond: very small.
Controlling factors in award: estimated value of property in its unused condition and relative proportion of water diverted to whole flow.
Arbitrators were three farmers. The water company made gagings of the stream at diversion point June 20 and 30, 1888, that showed an average flow of 650 000 gallons daily, including one storm. The stream at mill site gave a flow about eight times as large. Rubber Company claimed the diversion equal to 4 HP. in five summer months, and that it would cost $100 per year to replace it with steam, which. capitalized at 5 per cent., made the damage $2 000. Water Company claimed the damage could not exceed one eighth of market value of the real estate, say $100.

$2.45 PER SQUARE MILE PER FOOT OF FALL.

18 Connecticut, New London, 1897.
W. R. Perry *v.* City of New London.
DEVELOPED PRIVILEGE ON BRIGGS BROOK.
Authority: W. H. Richards, New London, and C. E. Chandler, Norwich, Conn.

BY AWARD, $8 000.

Watershed diverted: 1.64 out of 2 square miles.
Theoretical fall: 51 feet.
Watershed: rolling.
No storage reservoirs upon watershed.
Controlling factor in award: alleged value of stream for an ice privilege.
Award included land for dam site and pipe line right.
City's engineers claimed that there would be sufficient water for ice pond after diversion, and that 15 HP. was liberal rating of power development.

Perry's engineers claimed 25 HP. and that its market value undeveloped was $25 000 to $31 000.

$95.60 PER SQUARE MILE PER FOOT OF FALL, INCLUDING PIPE LINE RIGHT.

19 Connecticut, New London, 1897.

Rogers Bros. *v.* City of New London.

DEVELOPED PRIVILEGE ON BRIGGS BROOK.

Authority: W. H. Richards, New London, and C. E. Chandler, Norwich, Conn.

BY AWARD, $4 000.

Watershed diverted: 1.64 out of 2.4 square miles.
Ice pond.
Theoretical fall: slight.
No developed fall.
Watershed: rolling.
No storage reservoirs upon watershed.
Controlling factor in award: damage to ice privilege.
City's engineers claimed that the 245 acres of remaining watershed would supply Rogers 3 000 000 gallon ice pond, and consequently damage was nominal. They showed that four ice ponds in constant use in Norwich had only from 15 to 55 acres per million gallons pondage. Rogers' engineers claimed that a steam plant could be built on the Rogers' land, and that he should be paid the capitalized value of the coal saved by using the diverted water for condensing.

SPECIAL.

20 Connecticut, Norwich, New London County, 1894.

Falls Company *v.* Board of Water Commissioners of Norwich.

DEVELOPED WATER PRIVILEGES ON YANTIC RIVER.

Authority: C. E. Chandler, Norwich.

SALE, $5 000 (exclusive of interest).

Watershed diverted: 1.5 square miles out of 93 square miles.
Fall: 71 feet.
10 hour power.
Character of development: two good dams with 51 and 20 feet fall respectively.
Cotton mill at former and a file shop at latter with races, bulkheads, etc.
Watershed: ordinary, rolling.
Coal: $4.50 per short ton.
Steam used to some extent.

Moderate amount of water used for dyeing.
Four wheels, one of 500 HP. and one pair 250 HP. each on the 51 foot fall and one about 150 HP. on the 20 foot fall.
Total power required to run mill: 800 HP. at the 51 foot fall and 100 HP. extra for lights.
Supplementary steam or electricity used: 900 HP.
A full development at upper dam would include another and larger wheel and mill to use the power.
Area of mill ponds at the 51 foot fall, say ¼ acre; at the 20 foot fall, perhaps 5 acres.
Working depth of mill pond: the larger pond is usually emptied when necessary to save water.
Storage reservoirs upon watershed: one of 614 acres which can be drawn 7.4 feet in depth.
Complete control of storage by the company.
The price paid was the asking and only price for which the right could be obtained without a suit at law.

$47 PER SQUARE MILE PER FOOT OF FALL.

21 Connecticut, Norwich, New London County, 1881.
Board of Water Commissioners of the City of Norwich and S. B. Case.
DEVELOPED WATER PRIVILEGE ON HAMMER BROOK.
Authority: C. E. Chandler, Norwich, Conn.
SALE, $5 000 (exclusive of interest).
Tannery.
Watershed above privilege: 2.5 square miles.
Watershed diverted: 1.5 square miles.
Character of development: slight dam with vats, etc., for tanning leather.
Character of watershed: ordinary rolling.
Wholly used in tanning leather.
The property as a tannery had a very small value and was but little used after the sale.

$3 333 PER SQUARE MILE (for water, not power).

22 Connecticut, Norwich, New London County, 1894.
Ponemah Mills and Simeon Lord.
WATER USED FOR ICE POND, BUT PRACTICALLY NO POWER.
Authority: C. E. Chandler, Norwich, Conn.
BY AWARD, $1. (See remarks below.) LATER PURCHASE, $800.
Watershed above privilege: ⅛ square mile.
Watershed diverted: ¼ square mile.

Fall used: 5 feet.
Character of development: dam for ice purposes and hydraulic ram.
Character of watershed: ordinary rolling.
A manufacturing company, having no right of eminent domain to build a reservoir, built a reservoir to supply water to its village. The owner of a saloon had on the same stream below an ice pond and a hydraulic ram pumping water for his saloon and residence over it. The saloon keeper brought suit for $6 000 damages, claiming that his ice pond and water supply was injured. The manufacturing company's engineer claimed that whenever there was or would have been, any water flowing at the diverting point, there would be an ample supply for the ice pond and hydraulic ram where they were located, and hence damage was merely nominal. Damages awarded, $1. Later the right to divert was purchased for $800.

NOMINAL AWARD, $1.

LATER PURCHASE, $640 (?) PER SQUARE MILE PER FOOT OF FALL OR $\frac{800}{0.25}$ = $3 200 PER SQUARE MILE DIVERTED.

23 Connecticut, Plainville, Hartford County.

Hills Novelty Company and George W. Eaton *v.* City of New Britain.

DEVELOPED PRIVILEGE ON PLAINVILLE POND, PEQUABUCK RIVER.

Authority: Arthur T. Safford, Lowell, Mass.

BY AWARD, $6 500.

Watershed diverted: 7.15 square miles out of 46.4. All the water of the North Branch, so called.
Developed fall: 14.0 feet out of 15.07 feet.
11 hour power usually.
A wooden dam across Pequabuck River at the lower end of Plainville pond of 100 acres; power used on one side for making wood and metal novelties; on other side for grist mill.
Watershed: wooded and steep, elevation 1 000 feet and less, flat meadows and some swamp.
Steam is also used for heating at Hills Novelty Company; none at grist mill.
Water is used for sanitary purposes.
Two wheels installed: Novelty Company, 44 HP.; grist mill, 70 HP.
To improve privilege: raise dam.
Approximate area of mill pond: 100 acres.
Approximate depth to which mill pond can be drawn: 1 to 2 feet.

Five storage reservoirs upon watershed of about 43 000 000 cubic feet capacity, but drawn down and diverted already for water supply purposes; only overflow gets into stream; also two others of about 22 000 000 cubic feet.

First five controlled by water company; other two by concerns on small streams on which these reservoirs are located.

Controlling factors in award: loss of a little less than 8 HP. for eight months in the year from the stream where the storage in the mill pond at the dam was sufficient to take care of the night flow for the eight lowest months in the year.

Award did not include any allowances other than for water or water power.

A settlement was made by the owners from the engineer's reports before the diversion was actually made. This power is a good type of a small water power which has been used for a great many years and which with others has built up the small industries of Connecticut. This property has never been idle as far as I know.

$65 PER SQUARE MILE PER FOOT OF FALL.

24 Connecticut, Plainfield, Windham County, 1895.

Jewett City Water Company and Packer Manufacturing Company.

DEVELOPED WATER PRIVILEGE ON MILL BROOK.

Authority: C. E. Chandler, Norwich, Conn.

SALE, $1 600 (exclusive of interest).

Watershed above privilege: 20 square miles.

Watershed taken: $\frac{9}{10}$ square mile.

Fall: 47 feet.

Fall used: 19 feet fully developed, 20 feet partly developed and partly abandoned, 8 feet undeveloped.

10 hour power.

Character of development: dams, races, and so forth for making cloth, grinding grain, and sawing lumber.

Character of watershed: ordinary rolling.

Steam not used. Water used for power only.

Number of wheels installed: two 72 HP.

To improve the privilege: must put in expensive penstocks.

No storage reservoirs.

The arbitrator chosen by Packer Company claimed damage of $100 per foot mile, or $3 680, based on 40 foot fall, 0.92 square miles diverted, on the theory that this was about an average of a number of sales or awards in New Britain and other places. The arbitrator chosen by the Water Company claimed that, on account of the partial abandonment of the power and the abandonment of

many small powers in the vicinity, the damage to the market value was but little more than nominal.

$37.80 PER SQUARE MILE PER FOOT OF FALL.

25 Connecticut, Putnam, Windham County, 1895.
Putnam Water Company and George M. Morse.
UNDEVELOPED WATER PRIVILEGE ON LITTLE RIVER.
Authority: C. E. Chandler, Norwich, Conn.
BY AWARD, $2 250.

Watershed above privilege: 40.75 square miles.
Water diverted: 500 000 gallons daily.
Fall: 33 feet. None used.
Character of watershed: hilly but not mountainous.
Coal: $4.50 per ton.
To improve privilege: complete development and additional land and flowage rights.
Storage reservoirs upon watershed: Woodstock Lake, 86 acres. A natural lake without dam or gates.
The award was made by a committee consisting of a lawyer, a civil engineer, and a manufacturer. Mr. Morse's engineers claimed:

1. 500 000 gallons daily, with net fall of 30 feet, which would give 4.735 HP., for which he should be paid eight months in the year.

2. Each HP. should be valued at $50 per year, or $157.83⅓ for 4.735 HP. for eight months, which should be capitalized at 4 per cent., making $3 945.83.

Putnam Water Company's engineers claimed:

1. That this was absurd because at the same rate the 375 HP. which Mr. Morse's engineer claimed was minimum power would be worth undeveloped $218 000.

2. That $50 per HP. was wrong, because Mr. Morse's engineers said the same steam plant would be put in whether or not the diversion was made, and hence the cost of coal only should be considered, or $58.60 per annum.

3. That the capitalization should be 10 per cent. instead of 4 per cent.

4. That the privilege was not worth development and acquiring necessary additional land and rights.

5. That steam power could be developed for $22 per annum with a 500 HP. plant.

6. That it was a mile or more from a railroad and many miles from seaboard.

7. That, in view of all the above conditions, the market value of the land was not affected by the taking.

$4 500 PER MILLION GALLONS DIVERTED (undeveloped privilege),
OR $136 PER MILLION GALLONS DAILY PER FOOT OF FALL.

26 Connecticut, Southington, 1908(?).
F. L. Ellis & Son *v.* New Haven Water Company.
DEVELOPED WATER PRIVILEGE ON TEN MILE RIVER.
Authority: A. B. Hill, New Haven, Conn.
BY AGREEMENT, $500.
Builders' hardware.
Watershed taken: 1.6 out of 16.6 square miles.
Fall used: 5.7 feet.
10 hour power.
Character of watershed: narrow valley with steep side slopes.
Water used for power only.
One 14.5 HP. wheel installed.
Supplementary power necessary: 15 HP.
Mill pond: 150 000 cubic feet.
Usable power diverted (at 75 per cent. efficiency): 0.29 HP.
$54.80 PER SQUARE MILE PER FOOT OF FALL.

27 Connecticut, Thompson, Windham County, about 1870.
Grosvenordale Company and Oscar F. Chase.
DEVELOPED WATER PRIVILEGE ON FRENCH RIVER.
Authority: C. E. Chandler, Norwich, Conn.
SALE, $7 500 (exclusive of interest).
Watershed above privilege: 94 square miles.
Fall taken: 1½ feet of fall sold by Chase, the upper owner, to Grosvenordale Company, the lower owner.
10 hour power.
Full development for making cotton cloth.
Character of watershed: ordinary rolling.
This fall was probably available for the purchaser by the use of a flashboard at nominal cost for development and possibly it would have cost the seller a good deal to make it available for him.
$53.20 PER SQUARE MILE PER FOOT OF FALL.

28 Connecticut, Wallingford, 1908(?).
Borough of Wallingford *v.* New Haven Water Company.
DEVELOPED WATER PRIVILEGE ON QUINNIPIAC RIVER.
Authority: A. B. Hill, New Haven, Conn.

BY AGREEMENT, $2 000 (exclusive of interest).
Operated as auxiliary to steam electric light and power station.
Watershed above privilege: 110.5 square miles.
Watershed diverted: 1.6 square miles.
Fall used: 6.9 feet.
Character of development: electric light station.
Character of watershed: broad, sandy valley between high, rocky hills.
Steam is used for other purposes.
4 wheels: 25, 25, 35, and 100 HP.
Working capacity of mill pond: 500 000 cubic feet.
Usable power: 0.8 HP. (at 75 per cent. efficiency).
$181.20 PER SQUARE MILE PER FOOT OF FALL.

29 Connecticut, Waterbury.
James Roberts *v.* City of Waterbury.
DEVELOPED WATER PRIVILEGE ON WEST BRANCH, NAUGATUCK RIVER.
Authority: R. A. Cairns, Waterbury, Conn.
BY AWARD, $2 000.
Character of privilege: grist mill.
Watershed above privilege: 20 square miles.
Watershed diverted: 18 square miles.
Developed fall: 7 feet.
$15.90 PER SQUARE MILE PER FOOT OF FALL.

30 Connecticut, Waterbury.
Joseph Newell *v.* City of Waterbury(?).
DEVELOPED WATER PRIVILEGE ON WEST BRANCH OF NAUGATUCK RIVER.
Authority: R. A. Cairns, Waterbury, Conn.
BY AGREEMENT, $3 000.
Saw mill.
Area of watershed above privilege: 21 square miles.
Area of watershed diverted: 18 square miles.
Fall used: 12 feet.
$13.90 PER SQUARE MILE PER FOOT OF FALL.

31 Connecticut, Waterbury.
American Knife Company *v.* City of Waterbury.
DEVELOPED WATER PRIVILEGE ON WEST BRANCH OF NAUGATUCK RIVER.
Authority: R. A. Cairns, Waterbury, Conn.

BY AWARD, $7 000.
Character of privilege: factory for pocket cutlery.
Watershed above privilege: 23 square miles.
Watershed diverted: 18 square miles.
Developed fall: 13 feet.
$29.90 PER SQUARE MILE PER FOOT OF FALL.

32 Connecticut, Waterbury.
Henry Reynolds *v.* City of Waterbury.
DEVELOPED WATER PRIVILEGE.
Authority: R. A. Cairns, Waterbury, Conn.
BY AWARD, $1 200.
Character of privilege: saw mill.
Watershed above privilege: 23.2 square miles.
Watershed diverted: 18 square miles.
Developed fall: 7 feet.
$9.52 PER SQUARE MILE PER FOOT OF FALL.

33 Connecticut, Waterford, 1894.
Robertson Bros. *v.* City of New London.
DEVELOPED PRIVILEGE ON BEAVER DAM BROOK.
Authority: W. H. Richards, New London, and C. E. Chandler, Norwich, Conn.
BY AGREEMENT, $3 000.
Watershed diverted: 0.62 square miles out of 8.75.
Paper mill.
Theoretical fall: 33 feet.
Watershed: partly steep and partly swampy.
Water is used for paper making.
One rather large storage reservoir on watershed.
$147 PER SQUARE MILE PER FOOT OF FALL.

34 Connecticut, Waterford, 1894.
Oliver Woodworth *v.* City of New London.
DEVELOPED PRIVILEGE ON BEAVER DAM BROOK.
Authority: W. H. Richards, New London, and C. E. Chandler, Norwich, Conn.
BY AGREEMENT, $600.
Watershed diverted: 0.62 out of 8.75 square miles.
Paper mill.
Developed fall: 20 feet out of 20 feet.
24 hour power.

Watershed: partly steep and partly swampy.
Water is used for paper making.
One large storage reservoir upon watershed.
$48.40 PER SQUARE MILE PER FOOT OF FALL.

35 Connecticut, Wilton, 1903 and 1904.
City of South Norwalk, Norwalk Mills Company, Lounsbury-Bissell Company, Wm. F. Bishop, Mrs. Merwin.
DEVELOPED WATER PRIVILEGE.
Authority: Stephen S. Hatch, South Norwalk, Conn.
BY AWARD, $16 000 (approximate) for mill damages and water rights.
Character of privilege: permanent for all water that can be stopped.
Area of watershed above privilege: approximately 7 square miles.
Water diverted: with use of a 7-foot dam we get 7 500 000 gallons daily, when pipe is well covered.
This does not include watershed obtained in 1875. System is all gravity.

36 Connecticut, Windsor, Hartford County, 1907.
The Windsor Water Company, Charles F. Lewis (hereafter referred to as No. 1), L. L. Bedortha (hereafter referred to as No. 2).
DEVELOPED WATER PRIVILEGE ON MILL BROOK.
Authority: N. W. Hayden, Windsor, Conn.
BY AWARD, $2 675. The further agreement to allow the owner of the water privilege to connect at his own expense with one 6-inch main and install a hydrant, which he is to have free use of for twenty years for fire protection only.
Character of privilege: No. 1, grist and saw mill; No. 2, wood-working mill.
Watershed above privilege: 1 square mile above No. 1; practically nothing between No. 1 and No. 2.
Watershed taken: partially from 1 square mile.
Water taken: 200 000 gallons per twenty-four hours.
Fall: No. 1, 20 feet; No. 2, 9.8 feet.
Fall used: No. 1, 18.9 feet; No. 2, 8 feet.
8 hour power.
Character of development: No. 1, a country grist mill; No. 2, cigar bands, levels.
Character of watershed: woodland and pasture, sandy soil, not steep.
Coal: $5 per 2 000 pounds.

Steam is used in No. 1; No. 2, gasoline and producer gas.
Two wheels installed: No. 1 claimed 20 HP.; No. 2 claimed 9 HP.
Steam development: 40 HP.
Supplementary steam or electricity required: No. 1, extreme low water or when running saw mill, 20 HP.; No. 2, yes.
To improve privilege: No. 1, a new pond for which there is a good chance to give storage capacity at cost of $1 500, approximately; No. 2, fully developed.
Area of mill pond: a survey of pond of No. 1 showed area of 72 640 square feet.
Working depth of mill pond: No. 1, 1½ feet; No. 2, 3 feet.
No storage reservoirs.
Controlling factors of award: the award was a compromise. Our engineer, Mr. W. R. C. Corsons, figured damage at outside figure as No. 1 = $982; No. 2 = $488. Our opponents submitted no engineer's figures. Compromise was really based on these figures plus what their attorneys thought they could make it cost us to fight it out before a committee of the court.
In this state, water condemnation proceedings must be fought before a committee of three, appointed by a judge of the Superior Court, and all the expense must be borne by the Water Company.
$449 PER M.G.D. PER FOOT OF FALL.

37 District of Columbia, Washington, 1880.
The Great Falls Manufacturing Company of Virginia *v.* The United States.
DEVELOPED PRIVILEGE ON POTOMAC RIVER.
Authority: Francis F. Longley, Washington.
BY AWARD, $15 692 + expense of trial, $12 761.64 = $28 454.
Water supply of the District of Columbia.
No specific watershed diverted out of 11 043 square miles.
Amount of water diverted: not exceeded 71 000 000 gallons per day. Great Falls Mfg. Co. has formally recognized the right of the United States to take as much as 153 000 000 gallons per day.
Developed fall: diversion for water supply only. Entire fall still available for power development.
24 hour power.
Watershed: largely rough and mountainous, reached elevations of 4 000 feet. About one third of area wooded.
Water used only for water supply.
No storage reservoirs.
Controlling factors in award: (1) value of lands owned by claimants which were submerged by construction of dam for diversion of water supply; (2) value of the property rights of the claimants in

the water diverted from the Potomac River for the water supply of the District of Columbia.

SPECIAL DAMAGE.

38 Maine, ————, 1900, or thereabouts.

Names, Private.

UNDEVELOPED PRIVILEGE ON TRIBUTARY OF KENNEBEC RIVER.

Authority: Leonard Metcalf, Boston.

BY SALE, $13 000 approximately.

Total area of watershed above privilege: 200 square miles approximately.

Theoretical fall: 38 feet approximately in the aggregate; 775 HP., twenty-four hours, approximately $16 per HP.

$1.71 PER SQUARE MILE PER FOOT OF FALL.

39 Maine, ————, 1901, or thereabouts.

Names, Private.

UNDEVELOPED PRIVILEGE ON TRIBUTARY TO KENNEBEC RIVER.

Authority: Leonard Metcalf, Boston, Mass.

BY SALE, $24 000 approximately.

Total area of watershed above privilege: approximately 200 square miles.

Total fall: approximately 48 feet; 980 HP. approximately, $23.80 per 24 hour HP.

$2.50 PER SQUARE MILE PER FOOT OF FALL.

40 Maine, Waterville, 1903.

Maine Water Company *et al. v.* Kennebec Water District.

DEVELOPED PRIVILEGE.

Authority: Leonard Metcalf, Boston.

BY AWARD, $16 780.

Total area of watershed above privilege: 204 square miles.

Developed fall: 13 feet out of 13 feet =○= 265 HP. approximately =○= $63.40 ± per HP.

24 hour power available.

Temporary wooden buildings; timber dam in good condition.

Watershed: undulating, timber, and agricultural; soil, clayey.

Water is used for other purposes than for power.

Award included allowances other than for water or water power.

$6.32 PER SQUARE MILE PER FOOT OF FALL, INCLUDING SMALL ALLOWANCES FOR BUILDINGS, ETC.

41 Massachusetts, ————, 1899.
DEVELOPED WATER PRIVILEGE ON CHARLES RIVER.
Authority: Charles W. Sherman, Boston.
BY AWARD, $9 900 (exclusive of interest).
Diversion: 2 000 000 gallons daily.
Fall: at 5 mill privileges aggregating 26.7 feet.
Power utilized: as 10 hour power.
$185.40 PER MILLION GALLONS DAILY PER FOOT OF FALL.

42 Massachusetts, Andover, 1892.
Essex Company *v.* Andover.
DEVELOPED PRIVILEGE.
Authority: Richard A. Hale, Lawrence, Mass.
BY AGREEMENT, $1 200.
Drainage area: 2.7 square miles.
Fall: 30 feet.
Haggett's Pond taken for water supply. The town uses only a small portion of the total yield and there is some wasted into the Merrimac River. This was taken into consideration somewhat in connection with the amount fixed.
$14.80 PER SQUARE MILE PER FOOT OF FALL.

43 Massachusetts, Auburn, Worcester County, 1895.
Wm. J. Hogg *et al.* (Stoneville Worsted Company privilege) *v.* City of Worcester (Kettle Brook Cases No. 12).
DEVELOPED PRIVILEGE.
Authority: Charles T. Main, Boston.
BY AWARD, $12 786 (exclusive of interest).
Watershed taken: 3.856 square miles out of 15.2175 square miles.
Horse-power taken (F. A. McClure, authority): Petitioners' claim, 38.84; defendant's claim, 20.56.
Fall: 23.75 feet.
Character of development: worsted yarns for carpets.
Character of watershed: typical New England.
Coal: $4.15 per 2 000 pounds.
Steam is used for other purposes.
Water is used for other purposes.
One 138 HP. wheel installed.
Total steam and electric power development: 200 HP.
Total power required: 200 HP.
Area of pond: 40 acres.
Working depth of pond: 40 inches.
$139.50 PER SQUARE MILE PER FOOT OF FALL.

44 Massachusetts, Avon (as of August 12, 1889, with interest from said date. Award 1896 [?]).

Marcus M. Porter *v.* Town of Avon.

SPRING IN FARM OF PETITIONER — PORTER'S SPRING.

Authority: William Wheeler, Boston, Mass.

BY AWARD: (Jury Superior Court), $4 750.

Water taken: average for dry year about 90 000 gallons per day.

$52 750 PER MILLION GALLONS PER DAY.

45 Massachusetts, Ayer, Shirley, and Harvard. Taking 1898. Award 1904.

Nashoba Manufacturing Company *v.* Commonwealth of Massachusetts.

DEVELOPED PRIVILEGE ON NASHUA RIVER.

Authority: Leonard Metcalf, Boston.

BY AWARD, $20 000, or $27 300 including interest.

Watershed diverted: 118.3 out of 302 square miles; from 118.3 square miles, except 12 to 24 000 000 gallons of water to be let down weekly; diversion, 78 HP., 24 hours ±.

Developed fall: 8 feet out of 8 feet.

10 hour power.

Wooden A frame dam, and brick and wooden mill; had been out of service more or less. Used by Nashoba Manufacturing Company and Nashoba Chemical Company. Had two wheels and steam boiler plant. Buildings and 13 acres of land.

Watershed: rolling country; agricultural and partly wooded.

Coal: $4.50 per long ton.

Steam used to limited extent for manufacturing and other purposes.

Water used to limited extent for other purposes than power.

Wheels installed: 2 Houston turbines, 65 HP. each.

Total steam and electric power development: 130 HP. approximately.

Total power required to run mill: uncertain and comparatively small amount.

Very little supplementary steam necessary; none for power.

Dam and plant rebuilt soon after award was made.

Approximate area of mill pond: 9 000 000 square feet (8 miles long).

Approximate depth to which pond can be drawn: practically less than 1 foot.

Storage reservoirs upon watershed: Metropolitan Water Board and some others. Perhaps as much as 200 000 000 cubic feet on entire watershed.

Control of watershed fair; action not united.

Controlling factor in award: water diversion.

No allowances other than for water or water power.

Consensus of opinion or average opinion is perhaps represented by the following figures: 400 HP. installation warranted; development sixth to eighth month; total watershed, 302 square miles, of which approximately 40 per cent. diverted.

$21.20 PER SQUARE MILE PER FOOT OF FALL.

46 Massachusetts, Billerica, 1878.

C. P. Talbot *et al.* and J. R. Faulkner *et al. v.* City of Boston.

DEVELOPED PRIVILEGE ON SUDBURY RIVER (Old Middlesex Canal Dam).

Authority: William Jackson and C. W. Sherman, Boston.

BY AWARD	(1)	**$76 000**	**BY SETTLEMENT**	(1)	**$57 375**
	(2)	**20 000**		(2)	**15 000**
Total,		**$96 000**	**Total,**		**$72 375**

Total amount including interest, etc., (1) $59 224.81.

Total amount including interest, etc., (2) 15 641.68.

Watershed diverted: 75.2 square miles out of 352 square miles; all but 1.5 m.g.d. of water.

Fall: 11 feet.

Award: $116.90 PER SQUARE MILE PER FOOT OF FALL.

Settlement: $87.50 PER SQUARE MILE PER FOOT OF FALL.

47 Massachusetts, Blackstone, Worcester County, 1895.

Lawrence Felting Company *v.* City of Worcester. (Kettle Brook Cases No. 33.)

DEVELOPED PRIVILEGE.

Authority: Charles T. Main, Boston.

BY AWARD, $6 300 (exclusive of interest).

Watershed above privilege: 3.856 square miles out of 253.0526 square miles.

Horse-power taken (F. A. McClure, authority): Petitioner's claim, 24.14; defendant's claim, 5.87.

Fall: 15 feet.

Character of development: felt linings for rubber goods.

Coal: $3.75 per 2 000 pounds.

Steam is used for other purposes.

Water is used for other purposes.

Five wheels, 886 HP.

Total steam and electric power development: 140 HP.

Power required: 800 HP.

Area of pond: 25 to 50 acres.

$108.80 PER SQUARE MILE PER FOOT OF FALL.

48 Massachusetts, Blackstone, Worcester County, 1895.
Earl P. Mason Land Company (Waterford, Evans & Seagraves privilege) *v.* City of Worcester. (Kettle Brook Cases No. 35.)
DEVELOPED PRIVILEGE.
Authority: Charles T. Main, Boston.
BY AWARD, $3 990 (exclusive of interest).
Watershed diverted: 3.856 square miles out of 358.7658 square miles.
Horse-power taken (F. A. McClure, authority): Petitioner's claim, 17.15; defendant's claim, 4.20.
Fall: 10 feet.
Character of development: plant closed down.
Power required: 480 HP.
Area of pond: 50 acres.
$103.40 PER SQUARE MILE PER FOOT OF FALL.

49 Massachusetts, Blackstone, Worcester County, 1895.
Blackstone Manufacturing Company *v.* City of Worcester. (Kettle Brook Cases No. 34.)
DEVELOPED PRIVILEGE.
Authority: Charles T. Main, Boston.
BY AWARD, $12 285 (exclusive of interest).
Watershed diverted: 3.856 square miles out of 256.0511 square miles.
Horse-power taken (F. A. McClure, authority): Petitioner's claim, 51.69; defendant's claim, 12.64.
Fall: 32.047 feet.
Area of pond: 68 acres.
Working depth of pond: 3 feet.
$99.40 PER SQUARE MILE PER FOOT OF FALL.

50 Massachusetts, Braintree, Norfolk County, 1893.
Quincy Water Company *v.* Quincy.
DEVELOPED WATER PRIVILEGE.
Authority: William Jackson, Boston, Mass.
BY AWARD, $599 304.19 (including interest and allowances).
Watershed above privilege: 990 acres.
Watershed taken: 990 acres.
Watershed: hilly.
Storage reservoirs upon watershed: 180 000 000 gallons.
Award included mains, reservoir, and franchise.
This case was one involving no mill rights.
SPECIAL.

51 Massachusetts, Canton, 1900.
Lexington Print Works *v.* Town of Canton.
DEVELOPED WATER-POWER PRIVILEGE ON BEAVER BROOK.
Authority: William Wheeler, Boston, Mass.
BY AWARD, $1 000.
Watershed taken: about 2.60 square miles out of 2.68 square miles.
Amount of water taken: by collecting wells, estimated daily yield about 500 000 gallons.
Theoretical fall: 20.5 feet.
Fall used: 20.5 feet.
10 hour power.
Character of development: water power, silk print works.
Character of watershed: tillage, mowing and woodland.
Steam is used for manufacturing or other purposes.
Water is used for dyeing and printing also.
Approximate area of mill pond: 65 000 square feet.
Approximate depth to which mill pond can be drawn: 1.50 feet.
No storage reservoirs upon the watershed.
$18.80 PER SQUARE MILE PER FOOT OF FALL.

52 Massachusetts, Clinton, Worcester County, 1897.
Lancaster Mills, Sawyer's Mills *v.* Metropolitan Water Board.
FULLY DEVELOPED PRIVILEGE, WACHUSETT RESERVOIR.
Authority: Charles T. Main, Boston.
BY AGREEMENT, $535 000 (Water and Water Rights, Lancaster, $289 000; Sawyer's, $62 000).
Watershed diverted: Sawyer's, 113.4 square miles out of 113.4; Lancaster, 118.23 square miles out of 118.23. All water taken except 12 to 24 million gallons per week, which was used for other purposes than power.
Fall developed: Sawyer's, 15 feet out of 15.50 feet; Lancaster, 28 feet out of 28 feet.
58 hours per week power.
Stone dam. Product, Lancaster: ginghams, cheviots, dress goods. Sawyer's (in excellent condition), product: yarn.
Watershed: typical New England.
Coal: $4.46 per short ton.
Steam is used for manufacturing or other purposes.
Water is used for other purposes than for power.
Wheels installed: Lancaster, three, 535 HP. at 75 per cent. efficiency; Sawyer's, two, 196 HP. at 75 per cent. efficiency.
Total steam power development: Lancaster, 750 HP.; Sawyer's, 280 HP.

Total power required to run mill: Lancaster, 976 HP.; Sawyer's, 280 HP.
Supplementary steam is necessary, Lancaster, 755 HP.
Very little improvement necessary, Lancaster; Sawyer's might be developed up to about 340 HP.
Approximate area of mill pond: 96 acres, Lancaster; 71.6 acres, Sawyer's.
Approximate depth to which pond can be drawn: customary to draw 1 foot. Lancaster; Sawyer's maximum, 2 feet.
168 000 000 cubic feet storage reservoirs on watershed.
Storage controlled so as to be drawn out in times of low flow.
Controlling factors in award: both parties desire to settle amicably. Award based on extra cost of running mill after diversion.
Award included allowances for new steam plant; also land, mill buildings, tenements, and water power development at Sawyer's mill.

$87.30 LANCASTER, $35.20 SAWYER'S, PER SQUARE MILE PER FOOT OF FALL.

53 Massachusetts, Easthampton, Hampshire County, 1902.
Town of Easthampton *v.* City of Holyoke.
DEVELOPED PRIVILEGE (located on southwest branch of the Manhan River, which empties into the Connecticut).
Authority: J. L. Tighe, Holyoke.
BY AWARD, $22 000.
Watershed diverted: 13 square miles out of 60.5 square miles.
Fall developed: 16 feet out of 16 feet.
11 hour power.
Easthampton Water Works Pumping Station.
Watershed: mountainous, well wooded.
Auxiliary steam plant used only for pumping.
No water used for other purposes.
One wheel installed, 67 HP.; provision made for another.
To improve privilege: new dam must be built and another wheel installed.
Approximate area of mill pond: 1 acre ±.
Approximate depth to which mill pond can be drawn: 4 feet.
No storage reservoirs of any account upon watershed.
Controlling factors in award: claim that in time the pumping plant would have to be run twenty-four hours per day. Likewise, that the second wheel would soon be installed in order to run an electric plant for lighting town.
No allowances other than for the water or water power.

To the above award might be added about $5 000 for legal and expert fees.

$105.70 PER SQUARE MILE PER FOOT OF FALL.

54 Massachusetts, Framingham, 1878.
Saxonville Mills *v.* City of Boston.
DEVELOPED PRIVILEGE ON SUDBURY RIVER.
Authority: William Jackson and C. W. Sherman, Boston.
BY AWARD, $175 000. SETTLEMENT, $131 250 + Interest. Total amount, including interest, etc., $134 611.98.
Watershed diverted: 75.2 square miles out of perhaps 100 square miles. All except 1.5 m.g.d. of water.
Fall: 26 feet.
Award: $89.60 PER SQUARE MILE PER FOOT OF FALL.
Settlement: $67.20 PER SQUARE MILE PER FOOT OF FALL.

55 Massachusetts, Gardner (as of July 1, 1902).
Gardner Water Company *v.* Town of Gardner.
WATER SUPPLY PRIVILEGE IN CRYSTAL LAKE.
Authority: William Wheeler, Boston, Mass.
BY AWARD, $90 000.
Character of privilege: Water of natural lake or pond taken or acquired under statute for water supply purposes by Gardner Water Company.
Watershed taken: 607.5 acres.
Amount of water taken: estimated 850 000 g.p.d.
Character of watershed: improved land (with some residences) and woodland.
Valued separately incident to the determination of the price to be paid by the town for the property rights and privileges of the Gardner Water Company.
$106 000 PER MILLION GALLONS PER DAY.

56 Massachusetts, Gloucester (as of September 24, 1895), 1898.
City of Gloucester *v.* Gloucester Water Supply Company.
DEVELOPED WATER SUPPLY, DIKES MEADOW AND WALLACE BROOK.
Authority: William Wheeler, Boston, Mass.

BY AWARD: For water and water rights, exclusive of physical structures and lands,	**$175 000**
Lands and physical structures, additional,	**45 000**
For water and water rights, lands, and physical structures, but not including interest,	**$220 000**

Character of privilege: water of brook acquired or taken under statute and impounded for water supply purposes. Reservoired and improved.
Watershed taken: 585.5 acres.
Water taken: estimated daily average supply, 890 000 gallons per day.
Character of watershed: meadow and woodland.
Controlling factors in award: Valued separately incident to the determination of the fair value of all the corporate property, rights, and privileges of the Gloucester Water Supply Company purchased by the city of Gloucester.

$197 000 PER MILLION GALLONS PER DAY.

57 Massachusetts, Gloucester (as of September 24, 1895), 1898.
City of Gloucester *v.* Gloucester Water Supply Company.
UNDEVELOPED WATER SUPPLY, LILY POND AND MEADOW.
Authority: William Wheeler, Boston.
BY AWARD, $20 000 for water and water rights.
Character of privilege: Brook acquired and for a time used for water supply purposes without development, practically unreservoired and unimproved, but with right to use, and used to some extent for water supply purposes.
Watershed taken: 491 acres.
Theoretical fall: estimated 780 000 g.p.d.
Character of watershed: meadow and woodland.
Controlling factors in award: valued separately incident to the determination of the fair value of the corporate property rights and privileges of the Gloucester Water Supply Company purchased by the city of Gloucester.

$25 600 PER MILLION GALLONS PER DAY.

58 Massachusetts, Grafton, Worcester County, 1895.
Fisher Manufacturing Company (Fisherville privilege) *v.* City of Worcester. (Kettle Brook Cases No. 27.)
DEVELOPED PRIVILEGE.
Authority: Charles T. Main, Boston.
BY AWARD, $4 410 (exclusive of interest).
Watershed diverted: 3.856 square miles out of 127.4373 square miles.
Horse-power taken (F. A. McClure, authority): Petitioner's claim, 17.16; defendant's claim, 6.30.
Fall: 11.02 feet.
Character of development: fancy cottons.
Coal: $3.60 per 2 000 pounds.

Steam is used for other purposes.
Three wheels installed, 380 HP.
Total steam and electric power development: 750 HP.
Power required: 1 150 HP.
Area of pond: 130 acres.
Working depth of pond: 2 feet.

$103.70 PER SQUARE MILE PER FOOT OF FALL.

59 Massachusetts, Grafton, Worcester County, 1895.
Wm. H. Whitman (Farnumsville Cotton Mill privilege) *v.* City of Worcester. (Kettle Brook Cases No. 28.)

DEVELOPED PRIVILEGE.

Authority: Charles T. Main, Boston.

BY AWARD, $3 570 (exclusive of interest).

Watershed diverted: 3.856 square miles out of 128.3622 square miles.
Horse-power taken (F. A. McClure, authority): Petitioner's claim, 13.45; defendant's claim, 3.74.
Fall: 8 feet.
Character of development: cotton prints and drilling.
Coal: $3.60 per 2 000 pounds.
Steam is used for other purposes.
Two 160 HP. wheels installed.
Total steam and electric power development: 170 HP.
Power required: 300 HP. approximately.
Area of pond: 10 acres.
Working depth of pond: 1¼ feet.

$115.60 PER SQUARE MILE PER FOOT OF FALL.

60 Massachusetts, Grafton, Worcester County, 1895.
Saunders Cotton Mill, Saunders Grist Mill *v.* City of Worcester. (Kettle Brook Cases Nos. 25 and 26.)

DEVELOPED PRIVILEGE.

Authority: Charles T. Main, Boston.

BY AWARD, $7 980 (exclusive of interest).

Watershed above privilege: cotton mill, 85.5005 square miles; grist mill, 88.7790 square miles.
Watershed diverted: 3.856 square miles.
Horse-power taken (F. A. McClure, authority): Petitioners' claim, 20.60 and 11.11; defendant's claim, 3.64.
Fall: cotton mill, 12.77 feet; grist mill, 8.04 feet.
Character of development: cotton mill, sheetings, etc.; grist mill.

Coal: $3.75 per 2 000 pounds.
Wheels installed: cotton mill, four, 561 HP.; grist mill, one, 45 HP.
Total steam and electric power development: cotton mill, 250 HP.; grist mill, none.
Power required: cotton mill, 320 HP.
Area of pond: cotton mill, 10 acres; grist mill, 5 acres, perhaps.
Cotton mill can be drawn very little.

$99.40 PER SQUARE MILE PER FOOT OF FALL.

61 Massachusetts, Groton, Middlesex County, 1898.
Tileston & Hollingsworth Company *v.* Metropolitan Water Board.

FULLY DEVELOPED PRIVILEGE.

Authority: Charles T. Main, Boston.

BY AGREEMENT, $34 500.

Watershed diverted: 118.23 square miles out of 428.48 square miles. About 175 c.f.s. of water.
Developed fall: 7.5 feet out of 8 feet.
24 hour power.
Paper mill: water wheels supplemented by steam.
Watershed: typical New England.
Coal: $3.59 per short ton.
Steam not used for manufacturing or other purposes to any great extent.
Water not used for other purposes than for power to any great extent.
Five wheels installed, 342 HP. Usually run at about 180 HP.
Total steam power development: 200 HP. H-C engine; could develop 300 HP.
Total power required to run mill: average, 200 HP.
Supplementary steam rated at 200 HP.
Approximate area of mill pond: 140 acres.
Approximate depth to which pond can be drawn: 1 foot.
585 000 000 cubic feet storage reservoirs on watershed.
Storage controlled so as to be drawn during times of low flow.
Controlling factors in award: both parties desire to settle amicably. Award based on extra cost of running the mill after the diversion.
No allowances other than for the water or water power.
This was a paper mill with one paper machine and other machinery which goes to make a complete mill, driven when possible by water power, but at times of low or high water supplementary steam was used.

$37 PER SQUARE MILE PER FOOT OF FALL.

62 Massachusetts, Haverhill, 1896.
F. H. West *v.* City of Haverhill.
DEVELOPED MILL PRIVILEGE ON EAST MEADOW RIVER.
Authority: William Wheeler, Boston, Mass.
BY AWARD, $3 000.
Watershed taken: 7.75 square miles out of 7.75 square miles.
Amount of water taken: estimated 7 500 000 g.p.d.
Theoretical fall: 9 feet.
Fall used: 9 feet.
10 hour power.
Approximate area of mill pond: 66 670 square feet.
Approximate depth to which mill pond can be drawn: 1.2 feet.
$43.00 PER SQUARE MILE PER FOOT OF FALL.

63 Massachusetts, Haverhill, 1899.
Kendall Shattuck *v.* City of Haverhill.
DEVELOPED MILL PRIVILEGE ON EAST MEADOW RIVER.
Authority: William Wheeler, Boston, Mass.
BY AWARD, $3 000 (about).
Watershed taken: 7.5 square miles out of 7.5 square miles.
Amount of water taken: estimated 7 500 000 g.p.d.
Theoretical fall: 8 feet.
Fall used: 8 feet.
10 hour power.
Character of development: grain and cider mill.
Approximate depth to which mill pond can be drawn: 1 foot.
One wheel installed: 42-inch.
Approximate area of mill pond: 5 acres.
$50.00 PER SQUARE MILE PER FOOT OF FALL.

64 Massachusetts, Holyoke, 1900.
Lyons Bros. *v.* City of Holyoke.
DEVELOPED PRIVILEGE ON SOUTHWEST BRANCH OF MANHAN RIVER, WHICH EMPTIES INTO CONNECTICUT.
Authority: J. L. Tighe, Holyoke.
BY AWARD, $9 682.72, including interest.
Watershed diverted: 13 square miles out of 27.53 square miles; all the water from watershed diverted.
Developed fall: 13½ feet out of 13½ feet.
Intermittent power.
Saw and grist mill.
Watershed: mountainous.
No steam used for manufacturing or other purposes.

No water used for any other purposes than for power.
Two wheels installed; 40 inch Leffel, and 24 inch McCormick; total, 117 HP.
Approximate area of mill pond: 2 acres ±.
Approximate depth to which mill pond can be drawn: to any economic depth.
No storage reservoirs upon watershed.
Controlling factors in the award: diversion of water alone.
No allowances other than for water or water power.
Typical country sawmill and grist mill; as may be noticed, wheel capacity is over-developed. The reason was that the mills were independently run and both mills were never run at the same time.

$55.20 PER SQUARE MILE PER FOOT OF FALL, including interest.

$49.30 PER SQUARE MILE PER FOOT OF FALL, excluding interest (estimated).

65 Massachusetts, Hopkinton, Middlesex County, August 2, 1894.
(*a*) Dwight Printing Company, (*b*) Wood Bros. & Newhall *v.* City of Boston.
DEVELOPED WATER PRIVILEGE UPON SUDBURY RIVER BELOW WHITEHALL POND.
Authority: William Jackson, Boston, Mass.
BY AWARD, (*a*) $193 000; (*b*) $93 500. Total, $286 500 (includes real estate; not separable).
Area of watershed taken and diverted: 4.892 square miles.
Fall used: Wood Bros., 8.25 feet; Dwight Manufacturing Company, 13.5 feet.
Character of watershed: moderately hilly; typical New England watershed.
Storage reservoirs upon watershed: 1 256 900 000 gallons.
The award included real estate.

$2 694 PER SQUARE MILE PER FOOT OF FALL, including large amounts for land, etc. (special case).

66 Massachusetts, Hudson, Middlesex County, 1897.
F. Brigham & Co. *v.* City of Marlboro.
DEVELOPED MILL PRIVILEGE ON ASSABET RIVER.
Authority: William Wheeler, Boston, Mass.
BY AWARD, $3 440 (add interest at 6 per cent. from July 11, 1892).
Watershed taken: 3.39 square miles out of 64.26 square miles.

Amount of water taken:
Actual, 3 247 000 gallons per twenty-four hours.
Available, 1 238 000 „ „ „ „
Theoretical fall: 9 feet.
Fall used: 9 feet.
10 hour power.
Character of development: wool scouring, box making, and laundry. Partly in disuse since 1881 and 1894 owing to destruction of mills by fire.
Character of watershed: generally farming, pasturage, and woodland.
Three wheels installed, 123 HP.
Approximate area of mill pond: 2 166 000 square feet.
Approximate depth to which mill pond can be drawn: 1 foot.
Character of control: dam.

$113.00 PER SQUARE MILE PER FOOT OF FALL.

67 Massachusetts, Kingston, Plymouth County, 1907.
Town of Kingston *v.* City of Brockton.
DEVELOPED PRIVILEGE ON JONES RIVER.
Authority: Arthur T. Safford, Lowell, Mass.
BY AWARD, $17 000.

Watershed diverted: 4.4 square miles, including Silver Lake, out of 19.8 square miles; 4 000 000 gallons per day of water.
Developed fall: 8 feet out of 8 feet.
Power is used practically all the time.
Water power pumping plant for supplying town with water. Structures of wood, but in good condition.
Watershed: low (elevation less than 100 feet above sea level) meadows, swamps, and wooded, sandy.
Coal: $6 per short ton. Electric current, 3 cents per k.w.h.
No steam used for manufacturing or other purposes.
No water used for any other purposes than for power.
Wheels installed: one for pumping station; one for tack factory across the stream using surplus water; 25 HP.
Total power required to run pumps: 13 HP.
Supplementary current not used until after 1906, then 20 HP. motor; current from Plymouth, Mass.
Improvements: new wheel for pump; keeping water up in mill pond; cleaning out tailrace, estimated cost, $1 000.
Approximate area of mill pond: small, 5 acres.
Approximate depth to which pond can be drawn: 2 feet.
Storage reservoir: one at Silver Lake. Area at full lake, 646 acres; 540 000 000 gallons in upper 2.5 feet.

Control of storage: no deeded right, but accustomed to use storage with others at the outlet and lower down on the stream, and the town has had privilege of opening gates and letting out water when shops at outlet were shut down.

Controlling factors in award: the value of the storage which, previous to 1906, had made it possible for the town to pump continuously by water (with one exception when the flume was repaired) from 1886 to 1906; during very dry times the amount pumped was limited from upward of 300 000 gallons per day to perhaps 100 000 gallons; surplus power leased to tack factory for $300 a year; also the cost and maintenance of the electric motor and pumps to make up for 12.9 HP. for three months.

No allowance in award for other than water and water power.

The pumping station of the town of Kingston, operated by water power previous to 1906 without any auxiliary power, was, I believe, the only one of its kind in New England. The operating expenses per million gallons, $7.37,* are lower than any figures which I have been able to find. The pump operated itself and left the superintendent free to attend to all the business of the water works. The figures of the award were based practically upon replacing the power taken away for three months in the year with electric current bought from the Plymouth Electric Light Company, and the actual figures of maintenance in the future will not be less than the figures on which the award was based.

$483 PER SQUARE MILE PER FOOT OF FALL.

68 Massachusetts, Lancaster and Clinton, Worcester County, 1897.

George W. White *v.* Metropolitan Water Board.

DEVELOPED PRIVILEGE ON SOUTH BRANCH OF NASHUA RIVER.

Authority: Charles T. Main, Boston.

BY AGREEMENT, $35 000.

Watershed diverted: 118.2 square miles out of 128.8 square miles; 243 c.f.s. average of water.

Developed fall: 7.5 feet net head acting on wheels out of 8 feet.

Intermittent power.

Cotton mill: water wheels very old; dam in good condition.

Watershed: typical New England.

Three wheels installed; 150 HP. at 75 per cent. efficiency; no steam.

Total power required to run mill: 125 HP.

* Including salary of superintendent.

Approximate area of mill pond: 28.2 acres.
Approximate depth to which pond can be drawn: 1 foot.
168 000 000 cubic feet of storage reservoirs upon watershed.
Storage controlled so as to be drawn in times of low flow.
Controlling factors in award: both parties desired to settle amicably.
Whole property taken, but value of buildings and machinery very small.

$37 PER SQUARE MILE PER FOOT OF FALL.

69 Massachusetts, Lawrence, Essex County, 1896.
Essex Company *v.* Metropolitan Water Board (in Boston).
FULLY DEVELOPED PRIVILEGE ON MERRIMAC RIVER.
Authority: Charles T. Main, Boston.
BY AGREEMENT, $87 000 (exclusive of interest).
Watershed diverted upon the Nashua River, 118.23 square miles out of 4 599 square miles; 2.9 per cent. of water.
Developed fall: 30 feet out of 32.5 feet.
Largely 10 hour power, some 24 hour.
Very complete development belonging to Water Power Company furnishing water to various mills along the canals.
Watershed: typical New England.
Coal: $4.24 per short ton.
Steam is not produced by the Water Power Company, but by the water takers.
Water takers do use water for other purposes than power.
Water furnished to a large number of wheels belonging to different corporations.
Approximate working depth of mill pond: 3 feet.
Large number of storage reservoirs upon watershed tributary to Merrimac River.
Controlling factor in the award, desire to settle amicably.
No allowance in award other than for water or water power.

$22.62 PER SQUARE MILE PER FOOT OF FALL.

70 Massachusetts, Lawrence, Essex County, 1878.
Essex Company *v.* City of Boston.
DEVELOPED PRIVILEGE ON SUDBURY RIVER.
Authority: William Jackson and C. W. Sherman, Boston; Richard A. Hale, Lawrence.
BY AWARD, $35 000. SETTLEMENT, $26 250 + Interest. Total amount, including interest, etc., $27 164.59.
Total watershed: 4 553 square miles.
Watershed diverted: 75.2 square miles; all the water except 1.5 m.g.d.

Fall: 32 feet.

Settlement: $10.90 PER SQUARE MILE PER FOOT OF FALL.

Award: $14.50 PER SQUARE MILE PER FOOT OF FALL.

71 Massachusetts, Leicester, Worcester County.

Anjeanette K. Smith *v.* City of Worcester. (Kettle Brook Cases No. 6.)

DEVELOPED WATER PRIVILEGE.

Authority: Charles T. Main, Boston.

BY AWARD, $26 609 (exclusive of interest).

Watershed diverted: 3.856 square miles out of 6.1379 square miles.

Horse-power taken (F. A. McClure, authority): Petitioner's claim, 38.29; defendant's claim, 28.51.

Fall: 23.28 feet.

Character of development: flannels and dress goods; dyeing for other mills.

Character of watershed: typical New England.

Coal: $3.80 per 2 000 pounds.

Steam is used for other purposes.

Water is used for washing and dyeing.

One 80 HP. wheel installed.

Total steam and electric power development: 100 HP.

Total power required: 150 HP.

Area of pond: 8 to 10 acres.

$296.70 PER SQUARE MILE PER FOOT OF FALL.

72 Massachusetts, Leicester, Worcester County, 1895.

Leicester Water Power Company *v.* City of Worcester. (Kettle Brook.)

DEVELOPED PRIVILEGE.

Authority: Charles T. Main, Boston.

BY AWARD, $5 250 (exclusive of interest).

Watershed diverted: 3.856 square miles out of 4.8207 square miles.

Horse-power taken (F. A. McClure, authority): Petitioner's claim, 14.75.

Fall: 10.82 feet.

Character of development: storage reservoir between Kents, Lakeside Manufacturing Company, and Darling's Shoddy Mill, owned by an association of mill owners below.

Character of watershed: typical New England.

Area of pond: 70.46 acres.

Award practically for storage reservoir only. No power. Watershed actually diverted is 3.6158 square miles, to which is added half the

watershed of Peter Brook, since the tribunal included this area in making its awards.

SPECIAL.

73 Massachusetts, Leicester, Worcester County, Mass.

A. W. Darling, Lessee, *v.* City of Worcester. (Kettle Brook Cases No. 1)

DEVELOPED WATER PRIVILEGE.

Authority: Charles T. Main, Boston.

BY AWARD, $1 760 (exclusive of interest).

Watershed diverted: 3.856 square miles out of 4.8207 square miles.

Horse-power taken (F. A. McClure, authority): Defendant's claim, 20.86; petitioner's claim, 29.82.

Fall: 17.25 feet.

Character of development: small affair; shoddy.

Character of watershed: typical New England.

Steam is used for heating.

One wheel installed; 57 HP.

Total steam development: 55 HP.

Power required: 40 HP.

Area of pond: storage reservoir a few hundred feet above, 96 acres, owned by mill owners below.

Working depth of pond: little.

SEE KETTLE BROOK CASE NO. 2 — NEXT MILL.

74 Massachusetts, Leicester, Worcester County, 1895.

A. W. Darling *et al.*, Lessees, *v.* City of Worcester. (Kettle Brook Cases No. 1.)

DEVELOPED PRIVILEGE.

Authority: Charles T. Main, Boston.

BY AWARD $862 (exclusive of interest).

Watershed taken: 3.856.

Fall: 17.84.

(AWARD INCLUDED WITH CASE NO. 2.)

75 Massachusetts, Leicester, Worcester County.

E. D. Thayer, Owner, *v.* City of Worcester. (Kettle Brook Cases No. 2.)

DEVELOPED PRIVILEGE.

Authority: Charles T. Main, Boston.

BY AWARD, $30 669 (exclusive of interest).

Watershed taken: 3.856 square miles out of 5.0169 square miles.

Horse-power taken (F. A. McClure, authority): Petitioners' claim, 33.89; defendant's claim, 23.47.
Fall: 22.35 feet.
Character of development: woolens.
Coal: $4 per 2 000 pounds.
Live steam, heating, and drying.
Water is used for wool washing.
One wheel installed, 45 HP.
Power required to run mill: 110 HP.
Area of mill pond: 3 or 4 acres.
Award included: (*a*) Darling Shoddy Mill or (*b*) Bottomly Mill privilege; (*c*) undeveloped privilege.
(*a* and *b* are covered under Nos. 73 and 74.)

$211.20 PER SQUARE MILE PER FOOT OF FALL, including preceding case.

76 Massachusetts, Leicester, Worcester County, 1895.
E. D. Thayer *et al.* (Paxton Reservoir) *v.* City of Worcester.
NO POWER.
Authority: Charles T. Main, Boston.
BY AWARD, $36 750 (exclusive of interest).
Watershed diverted: 1.805 square miles out of 1.805 square miles.
Fall: variable.
Character of watershed: typical New England.
Award covers reservoir, dam, and land only; no power.
SPECIAL.

77 Massachusetts, Leicester, Worcester County.
Eli Collier (formerly Dixon privilege) *v.* City of Worcester.
(Kettle Brook Cases No. 4.)
DEVELOPED WATER PRIVILEGE.
Authority: Charles T. Main, Boston.
BY AWARD, $10 159 (exclusive of interest).
Watershed diverted: 3.856 square miles out of 5.1711 square miles.
Horse-power taken (F. A. McClure, authority): Petitioner's claim, 17.71; defendant's claim, 12.70.
Fall: 10.87 feet.
Character of development: 1 set mill; satinet.
Character of watershed: typical New England.
Cost of coal: $4 per 2 000 pounds.
Steam is used for other purposes.
Water is used for washing and fulling.
One 29 HP. wheel installed.

Total steam and electric development: 50 HP.
Power required: 40 HP.
Area of pond: 1¼ acres approximately.
Working depth: 18 inches perhaps.
$242.80 PER SQUARE MILE PER FOOT OF FALL.

78 Massachusetts, Leicester, Worcester County, 1895.
E. D. Thayer *et al. v.* Worcester.
ABANDONED PRIVILEGE.
Authority: Charles T. Main, Boston.
Watershed diverted: 2.528 out of 2.528 square miles.
Fall: 11 feet.
Saw mill privilege.
Includes dam and land.
SPECIAL.

79 Massachusetts, Leicester, Worcester County, 1895.
Town of Leicester *v.* City of Worcester.
DEVELOPED PRIVILEGE.
Authority: Charles T. Main, Boston.
BY AWARD, $1 890 (exclusive of interest).
Watershed diverted: 2.608 out of 2.608 square miles.
Fall: 18 feet.
Character of watershed: typical New England.
Award included land.
SPECIAL.

80 Massachusetts, Leicester, Worcester County, Mass.
Channing Smith, Lessee, *v.* City of Worcester. (Kettle Brook Cases No. 7.)
DEVELOPED WATER PRIVILEGE.
Authority: Charles T. Main, Boston.
BY AWARD, $2 212 (exclusive of interest).
Watershed diverted: 3.856 square miles.
Fall: 5.86 feet.
$98 PER SQUARE MILE PER FOOT OF FALL.

81 Massachusetts, Leicester, Worcester County, 1895.
E. D. Thayer *et al.*, Arnold Reservoir, *v.* City of Worcester.
ABANDONED PRIVILEGE.
Authority: Charles T. Main.
BY AWARD, $3 950 (exclusive of interest).
Watershed above privilege: 1.151 square miles.

Watershed taken: 1.151 square miles.
Fall: 8 feet.
Character of development: abandoned for many years. Old dam and rollway standing, nothing more.
Character of watershed: typical New England.
Area of pond: 5 or 6 acres.
Award covers reservoir, dam, and land only. No power.
SPECIAL.

82 Massachusetts, Leicester, Worcester County.
Waity M. Olney *et al. v.* City of Worcester. (Kettle Brook Cases No. 5.)
DEVELOPED WATER PRIVILEGE.
Authority: Charles T. Main, Boston.
BY AWARD, $36 550 (exclusive of interest).
Watershed diverted: 3.856 square miles out of 6.1379 square miles.
Horse-power taken (F. A. McClure, authority): Petitioners' claim, 46.62. Defendant's claim, 31.00.
Fall: 25.89 feet.
Character of development: six set mill. Blankets, etc. Has settling pond above.
Character of watershed: typical New England.
Coal: $3.90 per 2 000 pounds.
Steam is used for heating and washing.
Water is used for washing.
One wheel installed, 106 HP.
Total steam and electric power development: 90 HP.
Total power required: 150 HP.
Area of pond: 8 to 10 acres.
Working depth: perhaps 2 feet.
Award included: *a.* George W. Olney privilege.
b. Watson privilege.
c. Sawmill privilege.
$366.10 PER SQUARE MILE PER FOOT OF FALL.

83 Massachusetts, Leicester, Worcester County.
Newton Darling, Chapel Mills privileges, *v.* City of Worcester. (Kettle Brook Cases No. 3.)
DEVELOPED PRIVILEGE.
Authority: Charles T. Main, Boston.
BY AWARD, $14 671 (exclusive of interest).
Watershed taken: 3.856 square miles out of 5.0169 square miles.

Horse-power taken (F. A. McClure, authority): Petitioners' claim, 25.34. Defendant's claim, 17.30.
Fall: 14.77 feet.
Character of development: canal from tailwater of power above, about 873 feet long, 12 to 15 feet wide. Woolens.
Character of watershed: typical New England.
Cost of coal: $4.00.
Live steam for heating.
One 36 HP. wheel.
Total steam and electric power development: 50 HP.
Power required to run mill: 60 to 70 HP.

$257.50 PER SQUARE MILE PER FOOT OF FALL.

84 Massachusetts, Leicester, Worcester County, 1895.
Geo. Mann *et al. v.* City of Worcester.
DEVELOPED WATER PRIVILEGE.
Authority: Charles T. Main, Boston.
BY AWARD, $44 000 (exclusive of interest).
Watershed diverted: 3.0968 square miles out of 3.0968 square miles.
Fall: 49.75 feet.
Character of development: mill abandoned, dam cut by city of Worcester about May, 1896. Woolens and shoddy.
Character of watershed: typical New England.
Coal: $4.70 per 2 000 pounds.
Steam is used for heating mill.
Water is used for washing.
Two wheels installed, 87 HP.
Total steam and electric power development: about 40 HP.
Power required: probably 60 HP.
Area of pond: 24½ acres.
Working depth of pond: 2 feet.
Award included: *a.* Mann & Marshall mill and other premises.
b. Mann Bros. undeveloped privilege between reservoir and mill pond.
c. Mann Bros. mill pond and privilege.
d. Mann Bros. undeveloped privilege below mill.
Land, mill, and tenement buildings, canals, etc., included.

SPECIAL.

85 Massachusetts, Lowell, 1878.
(1) M. P. Wilder *et al. v.* City of Boston.
(2) L. W. Faulkner *v.* City of Boston.
(3) C. Brown Snyder *v.* City of Boston.

(4) Belvidere Woolen Company *v.* City of Boston.
(5) Sam'l N. Wood *v.* City of Boston.
(6) Lowell Bleachery *v.* City of Boston.
(7) Wamesit Power Company *v.* City of Boston.
(8) American Bolt Company *v.* City of Boston.

DEVELOPED PRIVILEGE ON SUDBURY RIVER (WAMESIT DAM).

Authority: William Jackson and C. W. Sherman, Boston.

BY AWARD: (1) $16 500; (2) $15 000; (3) $24 000; (4) $40 000, including damages at another privilege; (5) $7 500; (6) $6 000.

BY SETTLEMENT: (1) $12 375; (2) $11 287.50; (3) $18 072; (4) $30 000 (including also damages at another privilege; assume half to each privilege); (5) $5 643.74; (6) $4 515; (7) $55 000; (8) $9 000.

(7 and 8 did not join in suit.)

Total, $145 892.50 — $15 000 (⅘ other privileges) = $130 892.50.

Watershed diverted: 75.2 square miles out of 370±; all the water except 1.5 m.g.d.

Fall: 24.8 feet.

Settlement: $70.90 PER SQUARE MILE PER FOOT OF FALL (approximately) FOR 8 MILLS.

86 Massachusetts, Lowell, 1878.

Nancy L. Richmond *v.* City of Boston.

DEVELOPED PRIVILEGE ON SUDBURY RIVER.

Authority: William Jackson and C. W. Sherman, Boston.

BY AWARD, $23 000. SETTLEMENT, $17 307.50; $17 973.10, including interest, etc.

Watershed diverted: 75.2 square miles out of 375± square miles. All the water except 1.5 m.g.d.

Fall: 8 feet.

Award: $38.30 PER SQUARE MILE PER FOOT OF FALL.

Settlement: $28.80 PER SQUARE MILE PER FOOT OF FALL.

87 Massachusetts, Lowell, 1878.

Belvidere Woolen Company and Middlesex Company *v.* City of Boston.

DEVELOPED PRIVILEGE ON SUDBURY RIVER.

Authority: William Jackson and C. W. Sherman, Boston.

BY AWARD: (1) $40 000. Settlement, $30 000, including another privilege on Wamesit dam.

(2) Did not join in suit. Settlement, $22 544.95, including interest. Probably about $20 000 without interest.

Assuming one half of (1) to relate to other privilege. total settlement = $15 000 + $20 000 = $35 000.

Total Payment, including interest:

(1) $31 150.22.

(2) $22 544.95.

Watershed diverted: 75.2 square miles out of 380± square miles, All water taken except 1.5 m.g.d.

Fall: 11.3 feet.

Settlement: $41.10 PER SQUARE MILE PER FOOT OF FALL.

88 Massachusetts, Lowell, Essex County, 1896.

Locks and Canals Company *v.* Metropolitan Water Board.

FULLY DEVELOPED PRIVILEGE ON MERRIMAC RIVER.

Authority: Charles T. Main, Boston.

BY AGREEMENT, $116 000.

Watershed diverted: 118.23 square miles out of 4 085 square miles; 2.9 per cent. of water.

Developed fall: 34 feet out of 39 feet.

Largely 10 hour power, some 24 hour.

Very complete development belonging to the water power company furnishing water to the various mills along the canals.

Watershed: typical New England.

Coal: $4.24 per short ton.

No steam produced by the water power company; steam power produced by the water takers.

Water takers do use water for other purposes than for power; water power company does not.

Water furnished to a large number of wheels belonging to the different corporations.

Approximate area of mill pond: 1 125 acres.

Approximate depth to which mill pond can be drawn: 3 feet.

Storage reservoirs on watershed tributary to Merrimac River.

Controlling factor in the award: desire to settle amicably.

No allowances in award for other than water or water power.

$25.15 PER SQUARE MILE PER FOOT OF FALL.

89 Massachusetts, Maynard, Middlesex County, 1897.

Assabet Manufacturing Company *v.* City of Marlboro.

DEVELOPED MILL PRIVILEGE ON ASSABET RIVER.

Authority: William Wheeler, Boston, Mass.

BY AWARD, $8 385 (add interest at 6 per cent. from July 11, 1892).
Watershed taken: 3.39 square miles out of 113.12 square miles.
Amount of water taken:
Actual, 3 247 000 gallons per twenty-four hours.
Available, 1 238 000 „ „ „ „
Theoretical fall: 22.2 feet.
Fall used: 22.2 feet.
10 hour power.
Character of development: woolen goods.
Character of watershed: generally farming, pasture, and woodland.
Four wheels installed, 650 HP.
Approximate area of mill pond: 10 154 000 square feet.
Approximate depth to which mill pond can be drawn: 1 foot.
Character of control of storage: dam.
$111.00 PER SQUARE MILE PER FOOT OF FALL.

90 Massachusetts, Maynard, Middlesex County, 1897.
Assabet Manufacturing Company *v.* City of Marlboro.
DEVELOPED MILL PRIVILEGE ON ASSABET RIVER.
Authority: William Wheeler, Boston, Mass.
BY AWARD $4 225 (add interest at 6 per cent. from July 11, 1892).
Watershed taken: 3.39 square miles out of 113.12 square miles.
Amount of water taken:
Actual, 3 247 000 gallons per twenty-four hours.
Available, 1 238 000 „ „ „ „
Theoretical fall: 12 feet.
Fall used: 12 feet.
10 hour power.
Character of development: paper mill, burned in 18—.
Character of watershed: generally farming, pasture, and woodland.
Four wheels installed, 200 HP.
Approximate area of mill pond: 10 154 000 square feet.
Approximate depth to which mill pond can be drawn: 1 foot.
Character of control of storage: dam.
$103.50 PER SQUARE MILE PER FOOT OF FALL.

91 Massachusetts, Maynard, Middlesex County, 1897.
American Powder Mills *v.* City of Marlboro.
DEVELOPED MILL PRIVILEGE ON ASSABET RIVER.
Authority: William Wheeler, Boston, Mass.
BY AWARD, $4 080 (add interest at 6 per cent. from July 11, 1892).
Watershed taken: 3.39 square miles out of 115.61 square miles.

Amount of water taken:
Actual, 3 247 000 gallons per twenty-four hours.
Available, 1 238 000 „ „ „ „
Theoretical fall: 10.8 feet.
Fall used: 10.8 feet.
10 hour power.
Character of development: manufacture of powder.
Character of watershed: generally farming, pasture, and woodland.
Two wheels installed, 193 HP.
Approximate area of mill pond: 1 486 000 square feet.
Approximate depth to which mill pond can be drawn: 0.6 feet.
Character of control of storage: dam.

$111.00 PER SQUARE MILE PER FOOT OF FALL.

92 Massachusetts, Middleboro, 1909.

Town of Middleboro *v.* City of Taunton.

DEVELOPED WATER PRIVILEGE, NEMASKET RIVER.

Authority: George A. King, Taunton, Mass., and Leonard Metcalf, Boston.

AWARD, $7 500 ± exclusive of interest.

Interest from July 2, 1895, costs of court, and interest on decree to time of payment make total paid $13 913.63.

Area of watershed: 59 square miles.
Watershed diverted: 48.1 square miles + a portion from 10.9 square miles additional area.
Water diverted: actual, less than 2 m.g.d.; assumed, 5 m.g.d. approximately.
Fall: 10 feet.
Fall used: 10 feet.
24 hour power used.
Electric lighting plant.
Watershed: flat, sandy, partly wooded.
Coal: $4.50 per short ton.
Steam is used for power.
Water is not used for any other purpose than power.
Two 75 HP. wheels installed; 36-inch wheels.
Power development: 1 steam engine, 150 HP. 2 gas engines, 125 HP. each (?). Water power, 125 HP. to 150 HP.
Power required to run mill: 150 HP. approximately. Peak load, 300 HP. ±.
Supplementary steam and producer gas is necessary.
To improve privilege, power must be developed on other side of river. Now under other ownership.
Area of mill pond: 16 000 feet long by 100 feet wide.
12 000 000 gallons per foot depth.

Working depth of pond: efficient limit, say, 1 foot.
Storage reservoirs: 2.5 feet depth upon Assawompsett and Pocksha

Ponds,	2 160	million gallons.
Great and Little Quittacus,	1 190	„ „
Long Pond,	1 350	„ „
Total,	4 700	million gallons.

Character of control of storage: perfect.

The defendant claimed no damage, as the regimen of the stream was so improved by the provision for control of the lake outlet as to make the actual summer flow greater than before the development, in spite of the amount of diversion. The plaintiff claimed that while it might be to the interest of both parties to so control the discharge of water from the lake as to materially increase the summer flow, the actual control of the flash or weir boards had been taken out of their hands. Under the original act granting authority to divert water from these ponds for the water supply of Taunton, the right was granted to build a dam and raise the water level in the ponds 2.5 feet, or to such an amount as to provide one year's supply, and the city was required "to maintain . . . the natural flow . . . at all times."

$12.70 PER SQUARE MILE PER FOOT OF FALL.

93 Massachusetts, Nashua River Cases, 1896 or thereabouts.

SUMMARY OF METROPOLITAN WATER BOARD CASES.

Authority: Dexter Brackett, Boston.

AMOUNTS PAID BY AGREEMENT FOR DIVERSION OF WATER AND WATER RIGHTS TAKEN IN CONNECTION WITH THE METROPOLITAN WATER WORKS.

	Diversion of Water.	Value of Water Rights (Approximate).	Mill Property.	Depreciation of Real Estate and Loss of Business.	Total.	For Water or Water Rights per Square Mile per Foot of Fall.
Essex Company, Lawrence, Mass.	$87 000	.....	.....	.....	$87 000	$22.60
Locks and Canals, Lowell, Mass.	116 000	.....	.....	.....	116 000	25.15
Nashua Manufacturing Company, Nashua, N. H.	183 750	.....	.....	.....	183 750	33.60
Jackson Manufacturing Company, Nashua, N. H.	149 100	.....	.....	.....	149 100	58.00
West Boylston Manufacturing Company, Oakdale, Mass.	.....	$90 000	$435 000	.....	525 000	35.15
Clarendon Mills, West Boylston, Mass.	.....	53 000	187 000	.....	240 000	29.10
Lancaster Mills, Clinton, Mass.	289 000	.....	.....	.....	289 000	87.30
Sawyer's Mills, Clinton, Mass.	.....	62 000	184 000	.....	246 000	35.20
Holbrook Mills, West Boylston, Mass.	.....	22 000	78 000	.....	100 000	20.70
Cowee Mills, West Boylston, Mass.	.....	22 000	37 500	$13 000	72 500	20.70
White's Grist Mill, Lancaster and Clinton, Mass.	35 000	.....	.....	.....	35 000	37.00
Tileston & Hollingsworth Co., Groton, Mass.	34 500	.....	.....	.....	34 500	37.00
*Nashua River Paper Company, Pepperell, Mass.	145 895	.....	.....	.....	145 895	49.70
L. M. Harris Manufacturing Company, Oakdale Mass.	.....	52 000	142 000	.....	194 000	24.30

* Judgment,	$111 666.67
Interest,	34 186.82
Costs,	41.62
	$145 895.11

94 Massachusetts, Millbury, Worcester County, 1895.
Worcester and Suburban Street Railway Company *v.* City of Worcester. (Kettle Brook Cases No. 18.)
DEVELOPED PRIVILEGE.
Authority: Charles T. Main, Boston.
BY AWARD, $4 200 (exclusive of interest).
Watershed diverted: 3.856 square miles out of 57.8271 square miles.
Horse-power taken (F. A. McClure, authority): Petitioner's claim, 17.73; defendant's claim, 3.94.
Fall: 11.20 feet.
Character of development: electric current.
Coal: $4 per 2 000 pounds.
Water is used for other purposes.
1 wheel installed.
Total steam and electric power development: 500 HP.
Power required to run mill: probably 500 HP.
$97.20 PER SQUARE MILE PER FOOT OF FALL.

95 Massachusetts, Millbury, Worcester County, 1895.
Anna L. Morse *et al. v.* City of Worcester. (Kettle Brook Cases No. 19.)
DEVELOPED PRIVILEGE.
Authority: Charles T. Main, Boston.
BY AWARD, $2 940 (exclusive of interest).
Watershed diverted: 3.856 square miles out of 62.9134 square miles.
Horse-power taken (F. A. McClure, authority): Petitioners' claim, 13.22; defendant's claim, 2.84.
Fall: 8 feet.
Character of development: sash and blinds, inside finish.
Character of watershed: typical New England.
Coal: $3.80 per 2 000 pounds.
Two 116 HP. wheels installed.
Total steam and electric power development: 60 HP.
Power required: 90 to 100 HP.
Area of pond: 4 or 5 acres.
Working depth of pond: 18 inches.
$95.40 PER SQUARE MILE PER FOOT OF FALL.

96 Massachusetts, Millbury, Worcester County, 1895.
Wm. Harrington (Atlanta Mills privilege) *v.* City of Worcester. (Kettle Brook Cases No. 20.)
DEVELOPED PRIVILEGE.
Authority: Charles T. Main, Boston.

BY AWARD, $4 620 (exclusive of interest).

Watershed taken: 3.856 square miles out of 70.2969 square miles
Horse-power taken (F. A. McClure, authority): Petitioner's claim, 19.38; defendant's claim, 2.88.
Fall: 12.2 feet.
Character of development: not known; mill has been closed for a long time.
One wheel installed: 48 inches.
Area of pond: 3 to 4 acres.

$98.30 PER SQUARE MILE PER FOOT OF FALL.

97 Massachusetts, Millbury, Worcester County, 1895.
J. H. Mason *et al.* (Millbury Cotton Mill privilege) *v.* City of Worcester. (Kettle Brook Cases No. 21.)

DEVELOPED PRIVILEGE.

Authority: Charles T. Main, Boston.

BY AWARD, $4 830 (exclusive of interest).

Watershed diverted: 3.856 square miles out of 70.2969 square miles.
Horse-power taken (F. A. McClure, authority): Petitioners' claim, 20.91; defendant's claim, 4.51.
Fall: 13.1 feet.
Character of development: print goods.
Coal: $3.85 per 2 000 pounds.
Two 278 HP. wheels installed.
Total steam and electric power development: 220 HP.
Power required: 240 HP.
Area of pond: 1 acre.
Working depth of pond: little.

$95.70 PER SQUARE MILE PER FOOT OF FALL.

98 Massachusetts, Millbury, Worcester County, 1895.
Cordis Mills *v.* City of Worcester. (Kettle Brook Cases No. 22.)

DEVELOPED PRIVILEGE.

Authority: Charles T. Main, Boston.

BY AWARD, $5 460 (exclusive of interest).

Watershed diverted: 3.856 square miles out of 70.4939 square miles.
Horse-power taken (F. A. McClure, authority): Petitioner's claim, 23.74; defendant's claim, 5.28.
Fall: 14.27 feet.
Character of development: cotton tickings.
Coal: $3.60 per 2 000 pounds.

Steam is used for other purposes.
One 225 HP. wheel installed.
Total steam and electric power development: 240 HP.
Power required: 275 HP.
Area of pond: 7 acres.
Working depth of pond: 16 inches to 24 inches.
$99.30 PER SQUARE MILE PER FOOT OF FALL.

99 Massachusetts, Millbury, Worcester County, 1895.
Charles T. Aldrich (Aldrich Mill privilege) *v.* City of Worcester. (Kettle Brook Cases No. 23.)
DEVELOPED PRIVILEGE.
Authority: Charles T. Main, Boston.
BY AWARD, $5 040 (exclusive of interest).
Watershed diverted: 3.856 square miles out of 76.8691 square miles.
Horse-power taken (F. A. McClure, authority): Petitioner's claim, 23.02; defendant's claim, 2.88.
Fall: 16 feet.
Character of development: satinets.
Coal: $3.75 per 2 000 pounds.
Steam used for other purposes.
One 121 HP. wheel installed.
Total steam and electric power development: 180 HP.
Power required: 160 HP.
Area of pond: 5 acres.
Working depth of pond: 2 feet.
$81.80 PER SQUARE MILE PER FOOT OF FALL.

100 Massachusetts, New Bedford, 1899.
Town of Middleboro *v.* City of New Bedford.
DEVELOPED PRIVILEGE ON ASSAWOMPSETT POND, GREAT AND LITTLE QUITTACUS PONDS, LONG POND, ELDER'S POND, NEMASKET RIVER.
Authority: William F. Williams, New Bedford.
BY AGREEMENT, $4 800 (exclusive of interest); $6 800 (including interest for seven years).
Watershed diverted: 12.8 square miles out of 59 square miles; all of the water for the six dry months of the year.
Developed fall: 10 feet.
Water power used nights and steam or gas engine daytimes when water was low.
Character of development: generation of electric light and power.

Watershed: wooded land, grass land, general farming land, and some residential.
Steam is used for manufacturing or other purposes.
Water is not used for other purposes than for power.
Two turbine wheels installed of 75 HP. each.
Total steam and electric power development:
One 120 kilowatt machine.
One 35 „ „
One 50-light arc machine.
One 30 „ „ „
The plant had one 150 HP. McIntosh steam engine and one 125 HP. gasoline engine.
Approximate area of mill pond: from the dam at the power station to the dam at Assawompsett Pond was about 36 acres.
Controlling factors in award: city had previously settled the claim of one other mill owner on the Nemasket River for the sum of $4 500. The conditions were rather more favorable to Middleboro's claim; therefore the offer of counsel for the town to settle for $4 800 and interest was accepted without relation to the value of the privilege on a horse-power basis.
No allowance for other than water or water power.

This case was settled by the city solicitor before the engineers for the city had completed their estimates and the collection of data for the defense. In determining the amount of the Star Mill damage ($4 500) Messrs. Rice and Evans estimated the total horse-power equivalent of the water which the city might take to be 18 HP., which they gave a value of $5 000.

The act under which the city took the waters of Great Quittacus Pond did not follow the usual phraseology of water acts. See Sect. 6, Acts 345, 1894. "Said city shall be liable to pay all damages that may be sustained . . . by any owner of water rights on or below the Nemasket River caused by the diminution of the natural flow of the waters from Great Quittacus Pond under the provisions of this act." . . . "No application for assessment of damages shall be made for the taking of any water, water right, or any injury thereto until the water is actually withdrawn by said city under the authority of this act."

One of the ablest lawyers in this state drew the act and I am sure it was his intention to make the city liable only for the actual diminution of the natural flow from Great Quittacus. The damage was not created by the paper taking. The damage depended upon the actual diminution in flow and could not be determined prior to such diminution.

It would have been an interesting case to try and I was sorry to see it settled.

$37.50 PER SQUARE MILE PER FOOT OF FALL.

101 Massachusetts, Northampton, 1901.
———— *v.* City of Northampton.
DEVELOPED PRIVILEGE ON MILL RIVER.
Authority: J. L. Tighe, Holyoke.
BY AWARD, $6 500 (including interest).
Watershed diverted: 7.2 square miles out of 13 square miles; all of the water from watershed of 7.2 square miles.
Developed fall: 30 feet out of 30 feet.
10 hour power when running.
Grist and saw mill.
Watershed: mountainous.
No steam used for manufacturing or other purposes.
No water used for any other purposes than for power.
One wheel installed: 80 HP.
No steam or electric power development.
Auxiliary power needed in dry periods, but none installed.
Approximate contents of mill pond: 670 000 cubic feet.
No storage reservoirs upon watershed except as above.
Storage controlled by gates.
Controlling factor in award: damage to grist mill.
No allowances other than for water or water power.
The above plant was a typical one of the country sawmill or grist mill. It was located about three miles from the railroad and this fact lessened the value of the privilege. There is a large undeveloped fall here, but this was hardly considered at all in settlement of damages.
$30.90 PER SQUARE MILE PER FOOT OF FALL, INCLUDING INTEREST.
$27.60 PER SQUARE MILE PER FOOT OF FALL, EXCLUDING INTEREST (estimated).

102 Massachusetts, Northampton, 1901.
———— *v.* City of Northampton.
DEVELOPED PRIVILEGE ON WEST BROOK IN WEST WHATELY, MASS. (a tributary of Mill River, which empties into the Connecticut).
Authority: J. L. Tighe, Holyoke.
BY AWARD, $3 000 (including interest).
Watershed diverted: 7.2 square miles out of 13.1 square miles; all water from shed diverted.
Developed fall: 11.5 feet out of 18.5 feet.
10 hour power when running; mill run only intermittently.
Saw mill and general jobbing shop.

Watershed: mountainous.
No steam used for manufacturing or other purposes.
No water used for any other purposes than for power.
One wheel installed: 30 HP.
No steam and electric power development.
Total power required to run mill: all that the wheel would give at times.
Supplementary steam would be necessary for a uniform power.
Approximate area of mill pond: very small; has the use of the storage of 650 000 cubic feet of the ——— privilege.
Approximate depth to which mill pond can be drawn: any economical depth.
No storage reservoirs upon watershed except the ——— privilege.
Controlling factor in award: simply the damage done by diversion.
No allowances other than for the water or water power.

A typical country saw mill and grist mill. It was not used much for sawing or for making cider for many years, but confined entirely to running a job shop where the power needed was not more than from 10 to 20 HP.

$22.50 PER SQUARE MILE PER FOOT OF FALL, INCLUDING INTEREST.

$20.10 PER SQUARE MILE PER FOOT OF FALL, EXCLUDING INTEREST (estimated).

103 Massachusetts, Northampton, 1901.
——————— *v.* City of Northampton.

DEVELOPED PRIVILEGE ON WEST BROOK IN WEST WHATELY, MASS. (tributary of Mill River, which empties into the Connecticut).

Authority: J. L. Tighe, Holyoke.

BY AWARD, $5 000.

Watershed diverted: 7.2 square miles out of 13.2 square miles; all water from watershed diverted.
Developed fall: 22½ feet out of 22½ feet.
10 hour power when working.
Product: oatmeal, grain, and lumber.
Watershed: mountainous.
No steam used for manufacturing or other purposes.
No water used for any other purposes than for power.
One wheel installed: 60 HP.
Total power required to run mill: at times all of the 60 HP.
Supplementary steam or electricity would be necessary if it were necessary to have power uniform.

Approximate depth to which mill pond can be drawn: to any economical depth.
One storage reservoir upon watershed having 700 000 cubic feet capacity, which is the storage attached to the ——— privilege alone.
Controlling factor in award: damage alone.
No allowance for other than water or water power.

$30.90 PER SQUARE MILE PER FOOT OF FALL.

104 Massachusetts, Northampton, 1901.
——————— *v.* City of Northampton.
DEVELOPED PRIVILEGE ON MILL RIVER.
Authority: J. L. Tighe, Holyoke.
BY AWARD, $17 000 (including interest).
Watershed diverted: 7.2 square miles out of 47 square miles; all of water of the portion of watershed diverted.
Developed fall: 14.5 feet out of 14.5 feet.
10 hour power.
Product: machine tools and gun stock.
Watershed: partly mountainous and partly flat along valley of lower portion of stream.
Steam is sometimes used as an auxiliary in low water.
No water used for any other purposes.
Three wheels installed: 75 HP.
Total steam and electric power development: a gasoline engine of 50 HP.
Total power required to run mill: 70 HP.
Supplementary steam used in dry periods to the amount of 50 HP.
To improve privilege: construct new dam and more wheel capacity.
Approximate area of mill pond: very small; confined to bed of the stream.
Approximate depth to which mill pond can be drawn: to any economic depth.
No storage reservoirs of any account upon watershed, except the mill pond itself and storage at the ——— privilege of 628 000 cubic feet.
Control of storage: controlled by the ——— privilege.
Controlling factor in award: damage by diversion alone.
No allowances other than for water or water power.

$162.70 PER SQUARE MILE PER FOOT OF FALL, INCLUDING INTEREST.

$145.20 PER SQUARE MILE PER FOOT OF FALL, EXCLUDING INTEREST (estimated).

105 Massachusetts, Northbridge, Worcester County, 1895.
Riverdale Woolen Mill *v.* City of Worcester. (Kettle Brook Cases No. 30.)

DEVELOPED PRIVILEGE.

Authority: Charles T. Main, Boston.

BY AWARD, $4 830 (exclusive of interest).

Watershed diverted: 3.856 square miles out of 133.9949 square miles.
Horse-power taken (F. A. McClure, authority): Petitioner's claim, 18.93; defendant's claim, 3.47.
Fall: 13 feet.
Character of development: wool and shoddy mills.
Coal: $3.60 per 2 000 pounds.
Steam is used for heating purposes.
Water is used for other purposes.
Two 260 HP. wheels installed.
Total steam and electric power development: 325 HP.
Power required: about 250 HP.
Area of pond: 10 acres.

$96.30 PER SQUARE MILE PER FOOT OF FALL.

106 Massachusetts, Northbridge, Worcester County, 1895.
Paul Whitin Manufacturing Company (Rockdale privilege) *v.* City of Worcester. (Kettle Brook Cases No. 29.)

DEVELOPED PRIVILEGE.

Authority: Charles T. Main, Boston, Mass.

BY AWARD, $4 830 (exclusive of interest).

Watershed diverted: 3.856 square miles out of 131.7250 square miles.
Horse-power taken (F. A. McClure, authority): Petitioner's claim, 18.31; defendant's claim, 4.75.
Fall: 12.37 feet.
Character of development: cotton goods.
Coal: $3.60 per 2 000 pounds.
Steam is used for other purposes.
Three wheels installed, 330 HP.
Total steam and electric power development: 746 HP.
Power required: 1 200 HP.
Area of pond: 98 acres.
Working depth of pond: can be drawn down but little.

$101.10 PER SQUARE MILE PER FOOT OF FALL.

107 Massachusetts, Oakdale, Worcester County, 1896.
West Boylston Manufacturing Company *v.* Metropolitan Water Board.
FULLY DEVELOPED PRIVILEGE ON SOUTH BRANCH OF NASHUA RIVER.
Authority: Charles T. Main, Boston.
BY AGREEMENT: Water Rights, $90 000 + Mill Property, $435 000.
Watershed diverted: 94.8 square miles out of 94.8 square miles; all of the water diverted.
Developed fall: 27 feet out of 27 feet.
10 hour power.
White cotton mill.
Watershed: typical New England.
Coal: $4.25 per short ton.
Steam is used for manufacturing or other purposes.
Water is used for other purposes than for power.
Two wheels installed, 617 HP.
Total steam power development: 500 HP.
Total power required to run mill: 600 HP.
Nearly full amount of power required to run mill.
Approximate area of mill pond: 48 acres.
Approximate depth to which mill pond can be drawn: 3 feet.
Storage reservoirs upon watershed: capacity unknown.
Storage controlled so as to be drawn in times of low flow.
Controlling factor in award: both parties showed a disposition to settle amicably.
Award included allowances for mill buildings, machinery, tenements, and land. Tenements and land estimated at $100 000.
$35.15 PER SQUARE MILE PER FOOT OF FALL.

108 Massachusetts, Oakdale, Worcester County, 1896.
L. M. Harris Manufacturing Company *v.* Metropolitan Water Board.
FULLY DEVELOPED PRIVILEGE ON QUINEPOXET RIVER.
Authority: Charles T. Main, Boston.
BY AGREEMENT, $194 000 = (Water Rights, $52 000 + Mill, $142 000).
Watershed all diverted: Spinning mill, 53.76 square miles.
Weaving „ 54.23 „ „
Developed fall: Spinning mill, 20 feet out of 22.85 feet.
Weaving „ 14.5 „ „ „ 16.85 „
10 hour power.
Two distinct dams, ponds, canals, raceways, and wheel plants.

Product: cotton goods.
Watershed: typical New England.
Coal: $4.46 per short ton.
Steam is not used to any great extent for manufacturing or other purposes.
Water is not used to any extent for any other purpose than for power.
Spinning mill has 1 pair 24-inch Hunt wheels, 149 HP.
Weaving mill has 1 pair 33-inch Hercules wheels, 93 HP.
Total steam power development: Spinning mill, 90 HP.
Weaving „ 50 „
Total power required to run mill: Spinning mill, 160 HP.
Weaving „ 50 „
Supplementary steam or electricity equal to whole power of wheels.
Approximate area of mill pond: Spinning mill, about 4 acres.
Weaving „ „ 3 „
Approximate depth to which mill pond can be drawn: 1 foot.
Storage reservoirs on watershed of unknown capacity.
Storage controlled so as to be drawn in times of low flow.
Controlling factor in award: desire to settle amicably.
Allowances other than for water or water power: land, mill buildings, machinery, and tenements.

$24.30 PER SQUARE MILE PER FOOT OF FALL, EXCLUDING MACHINERY, LAND, AND BUILDINGS.

109 Massachusetts, Pepperell, Middlesex County, 1901.
Nashua River Paper Company *v.* Metropolitan Water Board.
DEVELOPED PRIVILEGE UPON NASHUA RIVER.
Authority: Charles T. Main, Boston.
BY AWARD, $111 666.67 ($145 895, including interest and costs).
Watershed diverted: 118.23 square miles out of, upper mill, 434.06 square miles; lower mill, 434.08 square miles; 192.68 c.f.s. of water.
Developed fall: Upper mill, 14 feet out of 14 feet.
Lower „ 5 „ „ „ 5 „
24 hour power.
Stone dam and fair development at upper mill; lower mill, very low head. Product, paper.
Watershed: typical New England.
Coal: $4.02 per short ton.
Steam is used for manufacturing and other purposes.
Water is used for other purposes than power.

Nine wheels installed: 1 54-inch Hercules, 1 60-inch Hunt, 1 45-inch Tyler, 3 36-inch Blake, 3 60-inch Hunt. Upper mill, 540 HP.; lower mill, 162 HP.
Total steam power development: upper mill, 670 HP.; lower, 370.
Total power required to run mill: upper mill, 715 HP. without lights; lower mill, 370 HP. without lights.
Supplementary steam necessary: upper mill, 350 HP.; lower mill, 160 HP.; connected with wheels.
To improve privilege: head could be increased at great expense, which did not seem warranted.
Approximate area of mill pond: 88.9 acres.
Approximate depth to which mill pond can be drawn: 1½ feet.
585 000 000 cubic feet of storage reservoirs on watershed.
Storage controlled so as to be drawn out in times of low flow.
Controlling factor in award: case settled in court after extended trial.
Award probably included some allowance for rearrangements and addition to steam plant.

$49.70 PER SQUARE MILE PER FOOT OF FALL.

110 Massachusetts, Southampton, 1900.
W. J. Lyman *v.* City of Holyoke.
DEVELOPED PRIVILEGE ON SOUTHWEST BRANCH OF MANHAN RIVER, WHICH EMPTIES INTO CONNECTICUT.
Authority: J. L. Tighe, Holyoke.
BY AWARD, $1 775.89 (including interest).
Watershed diverted: 13 square miles out of 34.72 square miles; all of the water.
Developed fall: 9 feet from November 1 to April 12; 5 feet, balance of year.
Intermittent power.
Saw mill.
Watershed: mountainous.
No water used for any other purposes.
Wheels: 1 48-inch Leffel; under 9-foot head, 39 HP.; under 5-foot head, 16 HP.
No supplementary steam or electricity is necessary.
One storage reservoir upon watershed of approximately 2 acres.
Character of control: mill pond for Lyons mill about one mile up stream.
Controlling factor in award: diversion of water alone.
No allowances for other than water or water power.

$15.16 PER SQUARE MILE PER FOOT OF FALL, INCLUDING INTEREST.

$13.53 PER SQUARE MILE PER FOOT OF FALL, EXCLUDING INTEREST (estimated).

111 Massachusetts, South Deerfield, 1906.
——————— *v.* Town of South Deerfield.
DEVELOPED PRIVILEGE ON MILL POND.
Authority: J. L. Tighe, Holyoke.
BY AWARD, $2 300 + 6 per cent for about two years.
Watershed diverted: 3.65 square miles out of 39.2 square miles.
Developed fall: 14.5 feet out of 14.5 feet.
10 hour power.
Product: machine tools and gun stock.
Watershed: partly mountainous and partly flat.
No steam used for manufacturing or other purposes except as an auxiliary in low water.
No water used for any other purposes than for power.
Three wheels installed: 75 HP.
Total steam and electric power development: a gasoline engine of 50 HP., or electricity.
Supplementary steam used in dry periods when gasoline power is used to the amount of 50 HP.
To improve privilege: construct new dam and a greater wheel capacity.
Approximate area of mill pond: small and confined to that caused by dam backing up water in bed of stream.
Approximate depth to which mill pond can be drawn: to any economic depth.
No storage reservoirs of any account upon watershed except the ——— privilege in West Whately, Mass., this being 638 000 cubic feet.
Storage controlled by the ——— privilege.
Controlling factors in award: damage caused by diversion.
No allowances other than for water or water power.
It was shown that while theoretically the South Deerfield fire district diverted the flow of 3.65 square miles of shed, on account of the population of the town, the actual amount taken would not exceed a few thousand gallons per day. This had quite an effect upon the jury, and most of them being farmers, to whom $1 000 appeared very big, gave a rather small verdict. Besides, the town being so small and poor, the verdict must be affected more or less thereby.

$43.50 PER SQUARE MILE PER FOOT OF FALL.

112 Massachusetts, Springfield, 1892.

Otis Company, Collins Manufacturing Company, Ludlow Manufacturing Company, Chicopee Manufacturing Company, and Dwight Manufacturing Company *v.* Springfield Water Company.

DEVELOPED WATER PRIVILEGE ON JABISH BROOK.

Authority: Elbert E. Lochridge, Springfield, Mass.

BY AWARD, JULY 16, 1902, $70 000 (representing a damage of $45 000 and 6 per cent.). This amount was paid to an attorney, Judge Everett C. Bumpus, of Boston. He secured the settlement for the mill owners and arranged for the division of the amount among them. The Ames Sword Company, American Bicycle Company (July 25, 1902), and Lamb Knitting Machine Company settled jointly for $3 000. This also represents a smaller sum and interest for ten years.

Springfield Water Department, of Springfield, diverted the water, corporate names of owners being given above. The mills listed lie along the Chicopee River from Ludlow, Mass., a distance of about six miles, to the junction of the Chicopee River with the Connecticut River in Chicopee.

Total watershed: several hundred square miles.

Watershed diverted: Jabish Brook watershed, 10.6 square miles.

Falls: Otis Company, 6.0 feet.
(Plus a portion included under Ludlow M'f'g Co.'s fall).
Collins Manufacturing Company, 13.5 ,,
Ludlow Manufacturing Company, 43.0 ,,
Chicopee Manufacturing Company, 28.0 ,,
Dwight Manufacturing Company, 33.0 ,,

Total, 123.5 feet

Character of development: manufacturing of jute, linen, cotton, and a great diversity of manufacturing uses in towns of Chicopee and Chicopee Falls.

No information given as to amount of power used for various products, inasmuch as this was a settlement and none of these figures were produced. The watershed area and number of feet of fall are definite enough, however, to secure figures on this basis.

Watershed diverted was largely swampy and no section of it has any steep slopes.

As far as is known, damages were purely for power, and as developments are very large, this division was small proportionately.

Supplementary steam and electricity at present time are used in all the mills.

Average (of 5 cases): $34.30 PER SQUARE MILE PER FOOT OF FALL.

113 Massachusetts, Springfield, 1878.

Dwight Manufacturing Company, Chicopee Manufacturing Company, Indian Orchard Mills, Ludlow Manufacturing Company, Collins Manufacturing Company *v.* Springfield Water Company. First diversion.

DEVELOPED WATER POWER ALONG THE CHICOPEE RIVER.

Authority: Elbert E. Lochridge, Springfield, Mass.

BY AGREEMENT:	**$5 655.89**	**Dwight M'f'g Company** (1)
	4 440.19	**Chicopee M'f'g Company** (2)
	1 924.48	**Indian Orchard Mills** (3)
	962.24	**Ludlow M'f'g Company** (4)
	1 897.20	**Collins M'f'g Company** (5)
	120.00	**Referee charges**
	$15 000.00	

Total watershed: several hundred square miles.

Watershed diverted: 8.1 square miles Broad, Axe Factory, Cherry Valley, and Higher brooks, all tributaries to Chicopee River in town of Ludlow. Settlement included all water which could flow from this area.

Fall taken and developed:

(1)	33	feet.
(2)	28	„
(3)	33	„
(4)	43	„
(5)	13.5	„
Total,	150.5	feet.

Character of development: manufacturing of jute, linen, cotton, and a great diversity of manufacturing uses in towns of Chicopee and Chicopee Falls.

No information given as to amount of power used for various products, inasmuch as this was a settlement and none of these figures were produced. The watershed area and number of feet of fall are definite enough, however, to secure figures on this basis.

Watershed diverted was largely swampy and no section of it has any steep slopes.

As far as is known, damages were purely for power, and as developments are very large, this diversion was small proportionately.

Supplementary steam and electricity at present time are used in all the mills.

$21.10 PER SQUARE MILE PER FOOT OF FALL, Dwight Manufacturing Company.

19.60 PER SQUARE MILE PER FOOT OF FALL, Chicopee Falls Manufacturing Company.

7.20 PER SQUARE MILE PER FOOT OF FALL, Indian Orchard Mills.

2.80 PER SQUARE MILE PER FOOT OF FALL, Ludlow Manufacturing Company.

17.30 PER SQUARE MILE PER FOOT OF FALL, Collins Manufacturing Company.

$12.30 PER SQUARE MILE PER FOOT OF FALL, *Average* (of 5 mills).

114 Massachusetts, Stow, Middlesex County, 1897.
C. W. and A. D. Gleason *v.* City of Marlboro.
DEVELOPED MILL PRIVILEGE ON ASSABET RIVER.
Authority: William Wheeler, Boston, Mass.
BY AWARD, $3 425 (add interest at 6 per cent. from July 11, 1892).
Watershed taken: 3.39 square miles out of 77.01 square miles.
Amount of water taken:
Actual, 3 247 000 gallons per twenty-four hours.
Available, 1 238 000 „ „ „ „
Theoretical fall: 11.5 feet.
Fall used: 11.5 feet.
10 hour power.
Character of development: woolen goods.
Character of watershed: generally farming, pasture, and woodland.
Two wheels installed, 125 HP.
Approximate area of mill pond: 1 282 000 square feet.
Approximate depth to which mill pond can be drawn: 1.5 feet.
Character of control of storage: dam.
$87.70 PER SQUARE MILE PER FOOT OF FALL.

115 Massachusetts, Sutton, 1895.
Sutton Manufacturing Company (Wilkinsonville privilege) *v.* City of Worcester. (Kettle Brook Cases No. 24.)
DEVELOPED PRIVILEGE.
Authority: Charles T. Main, Boston.
BY AWARD, $8 820 (exclusive of interest).
Watershed diverted: 3.856 square miles out of 84.7156 square miles.

Horse-power taken (F. A. McClure, authority): Petitioner's claim, 37.71; defendant's claim, 5.61.
Fall: 22 feet.
Character of development: print mill.
Coal: $4.60 per 2 000 pounds.
Steam is used for other purposes.
Two 258 HP. wheels installed.
Total steam and electric power development: 100 HP.
Power required: 300 HP.
Area of pond: 6 acres.
Working depth of pond: 2 feet.

$104.00 PER SQUARE MILE PER FOOT OF FALL.

116 Massachusetts, Uxbridge, Worcester County, 1895.
Calumet Woolen Company, (*a*) Calumet Privilege, (*b*) Hecla Privilege, *v.* City of Worcester. (Kettle Brook Cases Nos. 31 and 32.)

DEVELOPED PRIVILEGES.

Authority: Charles T. Main, Boston.

BY AWARD, $8 400 (exclusive of interest).

Watershed above privilege: Calumet, 138.8710 square miles.
Hecla, 140.0900 „ „
Watershed diverted: 3.856 square miles.
Horse-power taken (F. A. McClure, authority): Petitioner's claim, 35.87; defendant's claim, 9.25.
Fall: Calumet, 12.00 feet.
Hecla, 10.00 „
Character of development: Calumet, woolens.
Hecla, „
Coal: Calumet, $4.25 per 2 000 pounds.
Hecla, 3.70 „ „ „
Steam is used for manufacturing purposes.
Water is used for other purposes.
Wheels installed: Calumet, one 180 HP. wheel.
Hecla, three 159 „ „
Total steam and electric power development:
Calumet, 130 HP.
Hecla, 130 „
Power required: Calumet, 160 HP.
Hecla, 240 „
Area of pond: Calumet, 111 acres.
Hecla, 45 „
Working depth of pond:
Calumet, 1 foot.
Hecla, 2 „

A SINGLE AWARD FOR TWO PRIVILEGES.
$99 PER SQUARE MILE PER FOOT OF FALL.

117 Massachusetts, Waltham and Watertown, 1887 or later.
Boston Manufacturing Company *et al. v.* City of Cambridge.
DEVELOPED WATER PRIVILEGE ON CHARLES RIVER.
Authority: L. M. Hastings, Cambridge, Mass.*
BY AWARD, $15 000 (at 4 dams).
Area of watershed above privilege: Boston Manufacturing Company, 251.42 square miles less 66.64 account diversion through Mother Brook. Somewhat greater at Ætna Mills and Watertown dam.
Watershed diverted: 23 square miles. (Stony Brook.)
Water taken: average yield by agreement of engineers, 22.3 m.g.d.
Fall used: Boston Manufacturing Company, 12.10 feet.
" " " Bleachery, 4.00 "
Ætna Mills, 4.80 "
Watertown dam, 5.80 "
Total fall at dams, 26.70 feet.
Area of mill pond at Boston Manufacturing Company: about 5 miles long, say, 10 750 000 square feet.
Working depth of mill pond: 2 feet.
$24.40 PER SQUARE MILE PER FOOT OF FALL.

118 Massachusetts, Waltham (or Weston).
"Rhoades Mill" *v.* City of Cambridge.
DEVELOPED WATER PRIVILEGE ON BRANCH OF STONY BROOK.
Authority: L. M. Hastings, Cambridge, Mass.
BY AWARD, $1 700.61 (including small amount of land).
Watershed above privilege: 4.14 square miles.
Amount of watershed taken: 4.14 square miles.
Amount of water diverted: 4 HP. (estimated).
Fall used: 8 feet.
$51.35 PER SQUARE MILE PER FOOT OF FALL.

119 Massachusetts, Waltham, 1889 and 1898.
Roberts Mill *v.* City of Cambridge.
DEVELOPED WATER PRIVILEGE ON STONY BROOK.
Authority: L. M. Hastings, Cambridge, Mass.

* JOURNAL OF THE NEW ENGLAND WATER WORKS ASSOCIATION, June, 1893, p. 189.

BY AWARD: $23 468.33 in 1889.
1 877.09 in 1898.

Total, $25 345.42

Watershed diverted: 23 square miles out of a total watershed but very little larger.

Fall: 16 feet.

Value of water for manufacturing purposes included in award. This award included the value of the water diverted, and in addition an allowance of 900 000 gallons per day, to be taken by the Roberts Mill from the reservoir built by the city. This award included the value of the power and the value of the water for manufacturing purposes, which was claimed to be considerable. Exactly what the power was valued at I am unable to learn. The amount of power available at the Roberts Mill was estimated by the city of Cambridge at 45.33 HP. and the fall was 16 feet.

$69.29 PER SQUARE MILE PER FOOT OF FALL, INCLUDING SUBSTANTIAL VALUE OF WATER FOR MANUFACTURING PURPOSES AND ALLOWANCE OF 900 000 GALLONS OF WATER PER DAY.

120 Massachusetts, Waltham.

Nathaniel Sibley *v.* City of Cambridge.

DEVELOPED WATER PRIVILEGE ON STONY BROOK, PRACTICALLY ABANDONED.

Authority: L. M. Hastings, Cambridge, Mass.

BY AWARD, $10 000.

Watershed above privilege: 21½ square miles.

Watershed diverted: 21.5 square miles.

Water taken: 37.9 HP. at upper dam.
44.1 „ „ lower „

Fall used: upper dam, 10.14 feet.
Lower „ 19.5 „

Area of mill pond: 14.9 acres.

Working depth of mill pond: 2 feet.

This plant had been practically abandoned for a number of years.

$15.72 PER SQUARE MILE PER FOOT OF FALL (including value of water for manufacturing purposes).

121 Massachusetts, Wellesley, 1877.

Mill Owners *v.* Town of Wellesley.

DEVELOPED PRIVILEGE ON CHARLES RIVER.

Authority: Richard A. Hale, Lawrence, Mass.

AGREEMENT.

Diversion of 500 000 gallons per twenty-four hours from the Charles River. The town paid the mill owners at the rate of $46.07 per foot fall for 500 000 gallons per twenty-four hours, and if additional water was to be drawn, the same rates were to be applied.

$92.14 PER MILLION GALLONS PER DAY PER FOOT OF FALL.

122 Massachusetts, West Boylston, Worcester County, 1896.
Holbrook Mills *v.* Metropolitan Water Board.
DEVELOPED PRIVILEGE ON NASHUA RIVER.
Authority: Charles T. Main, Boston.
BY AGREEMENT. Water Rights, $22 000. Mill Property, $78 000.

Watershed diverted: 98.3 square miles out of 98.3 square miles; 198.5 c.f.s. of water.
Developed fall: 10.5 to 11 feet out of 11 feet.
10 hour power.
Log dam about 10 feet high, 110 feet long. Rest of development rather crude and inexpensive. Product, light sheetings, cheese cloth, butter cloth.
Watershed: typical New England.
Coal: $4.46 per short ton.
Wheels installed: 1 Rodney Hunt, 54-inch; 128 HP. on 11-foot head.
Total steam power development: 89 HP.
Total power required to run mill: 120 HP.
Supplementary steam necessary: average for nine months, 49 HP.
Privilege could be improved by raising dam 3 feet.
Approximate area of mill pond: 7.6 acres.
Approximate depth to which pond can be drawn: 2 feet.
Controlling factors in award: desire to settle amicably. Award based on extra cost of running mill after diversion.
Award included allowance for value of mill buildings and tenements, machinery, water power plant, and privilege.

$20.70 PER SQUARE MILE PER FOOT OF FALL.

123 Massachusetts, West Boylston, Worcester County, 1903.
Cowee's Grist Mill *v.* Metropolitan Water Board.
FULLY DEVELOPED PRIVILEGE ON NASHUA RIVER.
Authority: Charles T. Main, Boston.
BY AGREEMENT, $22 000 Water Rights + $50 500 Mill Property, etc.

Watershed diverted: 98.3 square miles out of 98.3 square miles; 197 c.f.s. average of water.

Developed fall: not over 11 feet out of 11 feet.
Intermittent power.
Product: grist mill.
Watershed: typical New England.
Wheels installed; 2 48-inch Leffel; 1 36-inch Upham, 125 HP.
Total power required to run mill: 125 HP.; no other power.
Approximate area of mill pond: 7.6 acres.
Approximate depth to which mill pond can be drawn: 2 feet.
Storage reservoirs upon watershed: unknown capacity.
Storage controlled so as to be drawn in times of low flow.
Controlling factors in award: both parties desired amicable settlement.
Award included allowances for land, mill buildings, and machinery

$20.70 PER SQUARE MILE PER FOOT OF FALL.

124 Massachusetts, West Boylston, Worcester County, 1896.
Clarendon Mills *v.* Metropolitan Water Board.
DEVELOPED PRIVILEGE ON NASHUA RIVER.
Authority: Charles T. Main, Boston, Mass.
BY AGREEMENT, $240 000 (= Water Rights, $53 000 + Mill Property, $187 000).
Watershed diverted: all out of 98.9 square miles.
Developed fall: 18.4 feet out of 18.4 feet.
10 hour power.
Dam of rough rubble work about 135 feet long and 8 feet high. Canal, excavated open channel, very low. Tailrace, excavated channel, rather long. Product: corset jeans, crochet quilts, and sateens.
Watershed: typical New England.
Coal: $4.46 per short ton.
Steam used for manufacturing or other purposes.
Water used for other purposes than for power.
Wheels installed: 1 30-inch Hunt; 1 pair 42-inch Humphrey. 178 HP. at 75 per cent. efficiency.
Total steam power development: 140 HP.
Total power required to run mill: 350 HP.
Supplementary steam used: 248 HP. average year.
Wise to develop privilege up to 350 HP.
Approximate area of mill pond: 5 acres.
Approximate depth to which mill pond can be drawn: about 1 foot.
About 168 000 000 cubic feet storage reservoirs upon watershed.
Storage controlled so that they can be drawn during seasons of low flow.
Controlling factor in award: disposition to settle amicably.

Award included allowances for mill buildings and machinery, and tenements. Tenements and land estimated at $34 000.
An old mill in poor condition.

$29.10 PER SQUARE MILE PER FOOT OF FALL.

125 Massachusetts, Westfield, 1900.
———— *v.* Town of Westfield.
DEVELOPED PRIVILEGE ON LITTLE RIVER.
Authority: J. L. Tighe, Holyoke.
BY AWARD, $3 100 (inclusive of interest).
Watershed diverted: 6.4 square miles out of 81 square miles; all the water of the watershed taken.
Developed fall: 8 feet out of 8 feet.
10 hour power.
Machine works lathes.
Watershed: mountainous.
No water used for other purposes except for washing.
One wheel installed, 50 HP.
Total power required: in 1900 one wheel running at full gate was able to furnish the power required.
Supplementary steam plant is installed as an auxiliary in the dry periods.
To improve privilege: install another wheel and enlarge canal.
Approximate area of mill pond: very small, of no account.
Approximate depth to which mill pond can be drawn: about 3 feet.
There were a few small storage reservoirs on watershed, but so small that they were not considered.
Controlling factor in award: nothing but the taking away of the power.
No allowances other than for water or water power.

$60.60 PER SQUARE MILE PER FOOT OF FALL, INCLUDING INTEREST.

$54.10 PER SQUARE MILE PER FOOT OF FALL, EXCLUDING INTEREST (estimated).

126 Massachusetts, Westfield, 1900.
———— *v.* Town of Westfield.
UNDEVELOPED PRIVILEGE ON MUNN'S BROOK, TRIBUTARY TO LITTLE RIVER.
Authority: J. L. Tighe, Holyoke.
BY AWARD, $500 (including interest).
Watershed diverted: 6.4 square miles out of 21 square miles; all the water in 6.4 square miles.

Developed fall: 10 feet out of 10 feet.
Power not used for years.
Cider mill, burned down.
Watershed: one half mountainous and the other half comparatively flat.
Wheel power when mill was in use: supposed to be 20 HP.
Approximate area of mill pond: the bed of stream only with storage caused by dam.
No storage reservoirs upon watershed.
Controlling factor in award: farm on which mill site was located more valuable with the mill site attached than without it.

$7.82 PER SQUARE MILE PER FOOT OF FALL, INCLUDING INTEREST.

$6.98 PER SQUARE MILE PER FOOT OF FALL, EXCLUDING INTEREST (estimated).

127 Massachusetts, Westfield, 1900.
——————— *v.* Town of Westfield.

TWO FULLY DEVELOPED PRIVILEGES ON LITTLE RIVER.

Authority: J. L. Tighe, Holyoke.

BY AWARD, $19 200 (including interest).

Watershed diverted: 6.4 square miles out of 76 and 80 square miles; total watershed diverted.
Developed fall: 10 feet and 18 feet out of 10 feet and 18 feet.
24 hour power.
Paper mills.
Watershed: mountainous.
Steam used as an auxiliary plant and for heating and drying purposes.
Water used for washing, etc.
Two wheels installed, Privilege No. 1, 112 HP.; two or three installed at Privilege No. 2, 235 HP.
Total power required to run mill: all that could be developed.
Supplementary steam used in dry periods equal to the total wheel power or nearly so.
Approximate area of mill pond: small.
Approximate depth to which mill pond can be drawn: to any economical depth, say 3 feet.
A few small storage reservoirs on watershed.
Controlling factor of award: taking away of the power.
No allowances other than for water and water power, except for interest.
The damage was a lump sum for both privileges: $19 200, including interest.

$107.00 PER SQUARE MILE PER FOOT OF FALL, INCLUDING INTEREST.

$95.60 PER SQUARE MILE PER FOOT OF FALL, EXCLUDING INTEREST (estimated).

128 Massachusetts, Westvale (Concord Junction), Middlesex County, 1897.

Damon Manufacturing Company *v.* City of Marlboro.

DEVELOPED MILL PRIVILEGE ON ASSABET RIVER.

Authority: William Wheeler, Boston, Mass.

BY AWARD, $3 715 (add interest at 6 per cent. from July 11, 1892).

Watershed taken: 3.39 square miles out of 116.84 square miles.

Amount of water taken:

Actual, 3 247 000 gallons per twenty-four hours.

Available, 1 238 000 „ „ „ „

Theoretical fall: 8.8 feet.

Fall used: 8.8 feet.

10 hour power.

Character of development: woolen goods and saw mill.

Character of watershed: generally farming, pasture, and woodland.

Four wheels installed, 79 HP.

Approximate area of mill pond: 2 073 000 square feet.

Approximate depth to which mill pond can be drawn: 1.2 feet.

Character of control of storage: dam.

$124.00 PER SQUARE MILE PER FOOT OF FALL.

129 Massachusetts, Worcester, 1895–96. Summary of **Kettle Brook Cases.**

Mill Owners on Kettle Brook and Blackstone River *v.* City of Worcester.

DEVELOPED PRIVILEGES.

Authority: Charles T. Main, Boston, Mass.; F. A. McClure, Worcester.

No.	Name.	Total Area. Square Miles.	Area Diverted.* Square Miles.	Gross Fall. Feet.	Award.	Award per Square Mile per Foot of Fall.
1.	Darling Shoddy Mill, Leicester, Mass.	4.82		17.25		
2.	Bottomly Mill, Leicester, Mass.	5.02	3.856	23.35		
				39.60	$32 291.00	$211.20
3.	Chapel Mill, Leicester, Mass.	5.02	3.856	14.77	14 671.00	257.50
4.	Collier Mill, Leicester, Mass.	5.17	3.856	10.87	10 159.00	242.80
5.	Olney Mill, Leicester, Mass.	6.14	3.856	25.89	36 550.00	366.10
6.	A. K. Smith, Leicester, Mass.	6.14	3.856	23.28	26 609.00	296.70
7.	C. Smith, Leicester, Mass.	?	–	5.86	2 212.00	98.00
8.	Thayer, Worcester, Mass.	6.57	3.856	39.44	41 370.00	272.00
9.	Darling, Worcester, Mass.	6.57	3.856	15.08	15 571.50	268.00
10.	Butler, Worcester, Mass.	6.57	3.856	17.77	17 920.00	261.80
11.	King, Worcester, Mass.	8.43	3.856	18.00	†12 618.00	182.00
12.	Stoneville, Auburn, Mass.	15.22	3.856	23.75	12 786.00	139.50
13.	A. Curtis, Worcester, Mass.	28.68	3.856	11.00	4 980.00	117.20
14.	Curtis M'f'g Co., Worcester, Mass.	29.75	3.856	14.00	6 275.00	116.10
15.	Hopeville, Worcester, Mass.	40.24	3.856	6.94	3 215.00	120.00
16.	Pakachoag, Worcester, Mass.	40.98	3.856	9.45	4 460.00	122.30
17.	Stevens, Worcester, Mass.	56.37	3.856	9.00	5 368.00	154.50
18.	Burling, Millbury, Mass.	57.82	3.856	11.20	4 200.00	97.20
19.	Morse, Millbury, Mass.	62.91	3.856	8.00	2 940.00	95.40
20.	Atlanta, Millbury, Mass.	70.30	3.856	12.20	4 620.00 (Mill closed)	98.30
21.	Millbury, cotton mills	70.30	3.856	13.10	4 830.00	95.70
22.	Cordis Mills, Millbury, Mass.	70.49	3.856	14.27	5 460.00	99.30
23.	Aldrich, Millbury, Mass.	76.86	3.856	16.00	5 040.00	81.80
24.	Sutton, Sutton, Mass.	84.71	3.856	22.00	8 820.00	103.80
25.	Saunders, Grafton, Mass.	85.50	3.856	12.77		
26.	Saunders, Grafton, Mass.	88.78		8.54		
				20.81	7 980.00	99.40
27.	Fisher, Grafton, Mass.	127.44	3.856	11.02	4 410.00	103.70
28.	Farnumsville, Grafton, Mass.	128.36	3.856	8.00	3 570.00	115.60
29.	Rochdale, Northbridge, Mass.	133.99	3.856	12.37	4 830.00	101.10
30.	Riverdale, Northbridge, Mass.	133.99	3.856	13.00	4 830.00	96.30

No.	Name.	Total Area. Square Miles.	Area Diverted.* Square Miles.	Gross Fall. Feet.	Award.	Award per Square Mile per Foot of Fall.
31.	Calumet & Hecla, Uxbridge, Mass.	138.87	3.856	12.00		
32.		140.09	3.856	10.00		
				22.00	$8 400.00	$99.00
33.	Lawrence Felting Company, Blackstone, Mass.	253.05	3.856	15.00	6 300.00	108.80
34.	Blackstone, Blackstone, Mass.	256.05	3.856	32.05	12 285.00	99.40
35.	Waterford, Blackstone, Mass.	358.76	3.856	10.00	3 990.00	103.40
36.	Bartlett & Ballou, Woonsocket, R. I.	365.21	3.856	16.00	1 648.00	
				18.33		
37.	O'Reiley Grist Mill (Woonsocket, R. I.)			18.33	268.50	
	Harris Woolen (Woonsocket, R. I.)			18.33	268.50	
	Lyman Mill (Woonsocket, R. I.)			18.33	446.00	
	Globe Mill (Woonsocket, R. I.)			18.33	945.00	
	Woonsocket Electric Machine, etc. (Woonsocket, R. I.)			16.66	3 717.00	103.95
	Ray Cotton (Woonsocket, R. I.)	365.21		13.00		
	Lippitt (Woonsocket, R. I.)			7.33	1 050.00	
	Lippitt (Woonsocket, R. I.)			16.66		
	Leicester Knitting (Woonsocket, R. I.)			7.00	210.00	
	Am. Worsted (Woonsocket, R. I.)			16.67	840.00	
	Eagle Mills (Woonsocket, R. I.)			14.66	1 092.00	
	Clinton (Woonsocket, R. I.)			14.66	1 680.00	
38.	Hamlet, Woonsocket, R. I.†	367.40	3.856	9.33	3 150.00	87.70
39.	Mannville, Cumberland, R. I.	426.15	3.856	18.82	7 980.00	109.80
40.	Valley Falls (Albion)	429.40	3.856	13.20	4 515.00	88.80
41.	Lonsdale (Cumberland, R. I.)	433.03	3.856	10.00	8 400.00	86.40
	Cumberland, R. I.	440.81	3.856	25.20		
	Lincoln, R. I.	440.81	3.856	15.20		
42.	Valley Falls, Valley Falls, R. I.	442.52	3.856	14.61	5 040.00	89.40
43.	Central Falls, R. I., 3 mills	472.07	3.856	10.79	1 680.00	
					1 155.00	
					1 200.00	
					4 035.00	97.00
44.	Pawtucket, R. I., 5 mills	472.52	3.856	7.07	525.00	82.15
				7.07	525.00	
				7.07	525.00	
				8.00	336.00	
				7.07	367.00	
45.	Pawtucket, R. I., 3 mills	472.52	3.856	17.02	2 810.00	92.45
				17.02	3 096.00	
				10.93	105.00	
					Average,	$137.22

* Includes half of the watershed of Peter Brook, since it is understood that the commissioners included this in making their awards.

† This award not accepted and another trial was held and new award made, figures of which are not available.

130 Massachusetts, Worcester, 1895.

Albert W. Darling *v.* City of Worcester. (Kettle Brook Cases No. 9.)

DEVELOPED WATER PRIVILEGE.

Authority: Charles T. Main, Boston.

BY AWARD, $15 571.50 (exclusive of interest).

Watershed diverted: 3.856 square miles out of 6.5723 square miles.
Horse-power taken (F. A. McClure, authority): Petitioner's claim, 24.28; defendant's claim, 13.35.
Fall: 15.08 feet.
Character of development: woolens, two set mills.
Steam is used for heating.
Water is used for other purposes.
One wheel installed, 30 HP.
Total steam and electric power development: 80 HP.
Power required: 75 HP.
Area of pond: 1 acre.
Working depth of pond: small.

$268.00 PER SQUARE MILE PER FOOT OF FALL.

131 Massachusetts, Worcester, 1895.

Curtis Manufacturing Company *v.* City of Worcester. (Kettle Brook Cases No. 14.)

DEVELOPED PRIVILEGE.

Authority: Charles T. Main, Boston.

BY AWARD, $6 275 (exclusive of interest).

Watershed diverted: 3.856 square miles out of 29.7476 square miles.
Horse-power taken (F. A. McClure, authority): Petitioner's claim, 20.98; defendant's claim, 6.88.
Fall: 14 feet.
Character of development: shoddy mill.
Coal: $3.75 per 2 000 pounds.
Steam is used for other purposes.
Water is used for other purposes.
Two wheels installed: 120 HP.
Total steam and electric power development: 100 HP.
Total power required: 150 HP.
Area of pond: 50 acres.
Working depth of pond: 2 feet.

$116.10 PER SQUARE MILE PER FOOT OF FALL.

132 Massachusetts, Worcester, 1895.
E. D. Thayer, Jr., *v.* City of Worcester. (Kettle Brook Cases No. 8.)
DEVELOPED WATER PRIVILEGE.
Authority: Charles T. Main, Boston.
BY AWARD, $41 370 (exclusive of interest).
Watershed diverted: 3.856 square miles out of 6.5723 square miles
Horse-power taken (F. A. McClure, authority): Petitioner's claim, 64.47; defendant's claim, 40.67.
Fall: 39.44 feet.
Character of development: woolens and cotton warp cassimeres.
Coal: about $4.00 per 2 000 pounds.
Steam is used for other purposes.
Water is used for other purposes.
Two wheels installed, 118 HP.
Total steam and electric power development: 280 HP.
Power required: 275 HP.
Area of pond: 2 acres.
Working depth of pond: 2 feet.
Award included Ashworth & Jones privilege, E. D. Thayer, Jr., privilege.
$272.00 PER SQUARE MILE PER FOOT OF FALL.

133 Massachusetts, Worcester, 1895.
Albert Curtis *v.* City of Worcester. (Kettle Brook Cases No. 13.)
DEVELOPED PRIVILEGE.
Authority: Charles T. Main, Boston.
BY AWARD, $4 980 (exclusive of interest).
Watershed diverted: 3.856 square miles out of 28.6828 square miles.
Horse-power taken (F. A. McClure, authority): Petitioner's claim, 16.65; defendant's claim, 9.02.
Fall: 11 feet.
Character of development: shoddy.
Coal: $3.75 per 2 000 pounds.
One wheel installed, 75 HP.
Area of mill pond: 161 acres.
Working depth of pond: 1 foot.
$117.20 PER SQUARE MILE PER FOOT OF FALL.

134 Massachusetts, Worcester, 1895.
Hopeville Manufacturing Company *v.* City of Worcester. (Kettle Brook Cases No. 15.)
DEVELOPED PRIVILEGE.
Authority: Charles T. Main, Boston.

BY AWARD, $3 215 (exclusive of interest).
Watershed taken: 3.856 square miles out of 40.2424 square miles.
Horse-power taken (F. A. McClure, authority): Petitioner's claim, 10,75; defendant's claim, 4.49.
Fall: 6.94 feet.
Character of development: woolens; 6 set mill.
Coal: $3.80 per 2 000 pounds.
Steam is used for other purposes.
Water is used for other purposes.
Two 62 HP. wheels installed.
Total power development: 250 HP.
Total steam and electric power development: 200 HP.
Area of pond: 7 acres.
Working depth of pond: very little.
$120.00 PER SQUARE MILE PER FOOT OF FALL.

135 Massachusetts, Worcester, 1895.
William J. Hogg (Pakachoag Mill privilege) *v.* City of Worcester. (Kettle Brook Cases No. 16.)
DEVELOPED PRIVILEGE.
Authority: Charles T. Main, Boston.
BY AWARD, $4 460 (exclusive of interest).
Watershed diverted: 3.856 out of 40.98 square miles.
Horse-power taken (F. A. McClure, authority): Petitioner's claim, 14.91; defendant's claim, 4.17.
Fall: 9.45 feet.
$122.30 PER SQUARE MILE PER FOOT OF FALL.

136 Massachusetts, Worcester, 1895.
George A. Stevens *v.* City of Worcester. (Kettle Brook Cases No. 17.)
DEVELOPED PRIVILEGE.
Authority: Charles T. Main, Boston.
BY AWARD, $5 368 (exclusive of interest).
Watershed diverted: 3.856 out of 56.3699 square miles.
Horse-power taken (F. A. McClure, authority): Petitioner's claim, 14.44; defendant's claim, 2.63.
Fall: 9 feet.
Character of development: grain mill.
Coal: $3.60 per 2 000 pounds.
Three 54 HP. wheels installed.
Power required: 75 HP.
Area of pond: 2 acres, including canal.

Working depth of pond: very little.

$154.50 PER SQUARE MILE PER FOOT OF FALL.

137 Massachusetts, Worcester, 1895.

Elizabeth A. Butler *v.* City of Worcester. (Kettle Brook Cases No. 10.)

DEVELOPED PRIVILEGE.

Authority: Charles T. Main, Boston.

BY AWARD, $17 920.25 (exclusive of interest).

Watershed diverted: 3.856 square miles out of 6.5723 square miles.
Fall: 17.77 feet.
Horse-power taken (F. A. McClure, authority): Petitioner's claim 28.36; defendant's claim, 19.70.
Character of development: satinets; 2 set mill.
Coal: $3.80 per ton.
Steam is used for other purposes.
Water is used for other purposes.
One wheel installed, 60 HP.
Total steam and electric power development: 90 HP.
Power required: 75 HP.
Area of pond: 2 acres.
Working depth of pond: little.

$261.80 PER SQUARE MILE PER FOOT OF FALL.

138 Massachusetts, Worcester, 1895.

H. W. King, Trustee, *v.* City of Worcester. (Kettle Brook Cases No. 11.)

DEVELOPED PRIVILEGE.

Authority: Charles T. Main, Boston.

BY AWARD, $12 618 (exclusive of interest). (See remarks.)

Watershed diverted: 3.856 square miles out of 8.4358 square miles.
Fall: 18 feet.
Character of development: satinet.
Coal: $3.70 per ton.
Steam is used for other purposes.
Water is used for other purposes.
One wheel installed, 100 HP.
Total steam and electric power development: 80 HP.
Power required: 80 HP.
Area of pond: 25 acres.
Working depth of pond: 3 feet.
This award was not accepted, and a new trial was held, results of which are not available.

$182.00 PER SQUARE MILE PER FOOT OF FALL.

139 Maryland, Relay, Baltimore and Howard counties, October 2, 1902.

The Baltimore County Water and Electric Company purchased from the Viaduct Manufacturing Company of Baltimore City.

DEVELOPED PRIVILEGE ON YANTIC RIVER.

Authority: Kenneth Allen, New York City.

BY PURCHASE: Right to divert 3 000 000 gallons of water per day with additional diversion up to 150 000 000 gallons per day in 5 000 000 gallon lots per day upon payment of $1 000 per million of rights.

Total watershed above privilege: about 280 square miles.

Amount diverted: 3 000 000 gallons daily out of total estimated average flow of 150 000 000 gallons daily.

Developed fall: about 10 feet. Effective on wheels: about 7 feet.

Power used during usual working hours.

Character of development: manufacturing telephones and other electrical appliances.

Watershed: hilly, partly wooded, partly cultivated.

Coal: $3 per short ton.

Steam used only as auxiliary.

Water used only for power.

Four wheels installed, three of 27 HP. and one of 35 HP. One of the four running under part gate only, so that total available HP. equals 90.

Total steam power development: 50 HP.

Total power required to run mill: 90 HP.

112 HP. probably available.

Mill pond about 400 feet by 1 000 feet, with available depth of about 2 feet.

There are a number of dams with pondage upon the watershed of unknown capacity.

Character of control of storage: that usual in cases of water power plants for mill operation.

Award did not include any allowances other than for the water power.

The controlling features in sale were as follows: In a report made October 7, 1901, to the Viaduct Manufacturing Company by Hill. Quick & Allen, consulting engineers, it was estimated that with the existing development of 90 HP. auxiliary steam would be required sixty-seven days in the year. The water which the Baltimore County Water Company proposed to divert at that time did not exceed 2 000 000 gallons per day, and their engineers estimated that the maximum future diversion would not exceed 10 000 000

gallons per day, " but he stated that, to avoid detracting from the market value of the property, should it ever be deemed advisable to sell out, the company would not want any restrictions placed on the amount of water withdrawn from the stream." There being no guarantee as to the amount of diversion and as it might, indeed, be thought desirable to enlarge the plant later, so as to supply certain additional districts, the consulting engineers suggested " as the fairest and best basis of a settlement for the proposed curtailment of these privileges *the discounted value of the entire anticipated water power at some remote future date.*" This date was placed at the year 1951 or in fifty years.

The cost per horse-power of steam power was taken at $50 more per annum than water power, from which the potential value of the 112 HP. available was estimated at $5 600 per annum, and this amount was, therefore, decided to be the annual loss that would be sustained by the Viaduct Manufacturing Company.

The matter was finally adjusted upon the terms given in the answer to Question No. 1.

$100.00 PER MILLION GALLONS PER FOOT OF FALL.

140 New Hampshire, ————————, 1907 to 1909.

Names private.

UNDEVELOPED PRIVILEGE,

Authority: Richard A. Hale.

BY SALE, $30 000 approximately, with provision for further payment under certain conditions in case of subsequent development of privilege.

Area of watershed: upwards of 3 000 square miles.

Available fall: less than 20 feet.

$4.70 PER SQUARE MILE PER FOOT OF FALL.

141 New Hampshire, Ashland, July 23, 1888.

The Winnepissiogee Lake Cotton and Woolen Manufacturing Company to Messrs. Cheney, Scribner, and Stowell, of Ashland, N. H.

DEVELOPED WATER PRIVILEGES: ONE AT OUTLET OF LITTLE SQUAM LAKE, ONE IN ASHLAND VILLAGE.

Authority: W. E. Buck, Worcester, Mass.

SALE, $10 000, including 2 mills and various parcels of land.

Total watershed above privilege: 56¾ square miles.

Developed fall: at outlet, 15 feet; at Ashland Village, 14 feet.

Power used 24 hours per day.

Character of development: saw mill at outlet of lake; grist mill at Ashland Village.
Character of watershed: hilly and well wooded.
Area of mill pond: 11¾ square miles.
Working depth of mill pond: 3.5 feet.
Storage reservoirs upon watershed: Great and Little Squam Lakes. Nearly complete control of storage by company.
The power at the outlet varies as the lakes are drawn down to supply the river. The Lake Company were under agreement to supply 75 c.f.p.s. on 24 hour schedule to the mill owners below whenever that amount would flow, and the supply seldom fell below that amount.
The power at Ashland Village is a very reliable power and was in use at time of sale for a grist mill and to run a small repair shop. The mills of course were included in the sale and various lots of land along the outlet of Little Squam Lake.

$6.08 PER SQUARE MILE PER FOOT OF FALL (including buildings and land).

142 New Hampshire, Bristol, July 29, 1884.

The Winnepissiogee Lake Cotton and Woolen Manufacturing Company to Josiah Minot, of Concord, N. H., and David Mason, of Bristol, N. H.

DEVELOPED WATER PRIVILEGES AT OUTLET OF NEWFOUND LAKE AND ON NEWFOUND RIVER.

Authority: W. E. Buck, Worcester, Mass.

SALE, $15 000 (exclusive of interest).

Watershed above privilege: 91 square miles.
Developed fall: at lake, about 9 feet, but less when lake is drawn down to supply river; at village, one power of entire river, 30-foot fall; one of about one-half river on 14-foot fall.
24 hour power.
Character of development: saw mill at outlet of lake; large power was in use for pulp mill at village; small power in use for repair shop.
Character of watershed: hilly and well wooded.
Area of Newfound Lake: 7¾ square miles.
Working depth of lake: 3 to 4 feet.
Control of storage good, but not sufficient storage to fully control water. Lake never fails to fill in spring, and large quantities of water run to waste at this season of year.
The power at outlet of lake is not of much value as the head is drawn down every season to supply the river. In most seasons the lake

will maintain a constant flow of about 90 c.f.s. for 24 hours per working day. The lower power at Bristol Village has the entire flow of the Newfound River on an available fall of 30 feet. This power well situated for a ground wood-pulp mill or an electric power station, but not for general mill use, as there is very little yard room. Above this, the small power, taking about half the flow of the river on 14-foot fall, is not of much value.

$3.58 PER SQUARE MILE PER FOOT OF FALL.

143 New Hampshire, Manchester, 1907.
Devonshire Mills *v.* City of Manchester.
DEVELOPED PRIVILEGES ON LAKE MASSABESIC.
Authority: George A. Kimball, Boston.
BY AWARD, $50 000 (exclusive of interest).

Watershed diverted: 45 square miles out of total area 66 square miles. The right to divert all the water above the outlet of Lake Massabesic, a watershed of 45 square miles.
Theoretical fall: 46 feet. Developed fall: 12 feet and 28 feet = 40 feet.
10 hour power.
Fourteen set mills used for production of woolen cloth.
Watershed: hilly.
Coal: $5.50 per long ton.
Steam used for wool scouring, dyeing, and heating mills.
Water used for wool scouring: about 350 000 gallons per day.
Water furnished to two wheels: 27-inch McCormick, 196 HP.; 48-inch Leffel.
Two horizontal boilers, 150 HP.; 1 horizontal, small; 1 steam engine, 225 HP.
To improve privilege: combine the two falls and utilize the whole fall of 46 feet.
Approximate area of mill pond: 53 acres.
Approximate depth to which mill pond can be drawn: 5.33 feet.
Storage reservoirs on watershed: 2 350 acres.
Control of storage: doubtful.
Allowances included use of water for wool scouring.

$24.20 PER SQUARE MILE PER FOOT OF FALL.

144 New Hampshire, Nashua, 1901.
Vale Mills *v.* Groton, Mass., Water Company.
DEVELOPED PRIVILEGE ON SALMON BROOK.
Authority: Arthur T. Safford, Lowell, Mass.

BY AWARD, $2 500, including small amount for interest and collateral items.

Watershed diverted: 1.1 square miles, including Baddacook Pond of about 100 acres, out of 29 square miles; 100 000 gallons per day of water; later, 200 000 gallons.

Developed fall: average, 14.79 feet for spinning mill out of 14 feet; average, 10.57 feet for weaving mill out of 11 feet.

12 hour power.

Two adjoining water powers; dams with masonry abutments across Salmon Brook in fair condition. Pondage and storage rights well defined; at time of award cotton mills shut down and since sold.

Watershed: wooded and cultivated land; swamps mostly between elevations 200 and 300; large shallow ponds and reservoirs.

Coal: must have been about $5 per short ton.

Steam was used for heating mills.

Water was used for sanitary purposes.

One wheel at each mill. Lower mill, 100 HP.; upper, 50 HP.

Total steam and electric power not known exactly, but must have been about 250 HP.

Total power required to run mill not known (shut down for good at time of investigation).

Supplementary steam or electricity was necessary at lower mill; amount not known.

To improve privilege: new wheels, perhaps $2 000.

Approximate area of mill pond: spinning mill, 6 acres; weaving mill, 4 acres.

Approximate depth to which mill pond could be drawn: possibly 2 feet.

Storage capacity on reservoirs: 8 reservoirs and ponds; area about 600 acres; capacity, roughly, 100 000 000 cubic feet.

Storage bought and controlled by predecessors of Vale Mills; cannot hold back natural flow of Salmon Brook, but control probably furnishes the equivalent of an addition of 25 cubic feet per second for three months.

Controlling factors in award: loss of about 5 HP. for greater part of year; settlement made out of court with small expense.

Award did not include any allowances other than for the water or water power.

This settlement was based upon report of engineer and may have been influenced by fact that mills were shut down at the time and offered for sale. The stream, Salmon Brook, on which this power is situated, is a very good one and has been used for power purposes for more than sixty years.

$89.70 PER SQUARE MILE PER FOOT OF FALL, including small allowance for interest and collateral items.

145 New Hampshire, Nashua, Hillsboro County, 1896.
Nashua Manufacturing Company and Jackson Company, Runnell's Bridge, *v.* Metropolitan Water Board.
FULLY DEVELOPED PRIVILEGES ON NASHUA RIVER.
Authority: Charles T. Main, Boston.
BY AGREEMENT, Nashua, $183 750; Jackson, $149 100.

Watershed diverted:

Nashua,	118.23	out of	522.03	square miles.
Jackson,	118.23	„ „	527.34	„ „
Runnell's Bridge,	118.23	„ „	506.1	„ „

Developed fall:

Nashua,	34.5	feet	out of 35.25	feet.
Jackson,	21.75	„	„ „ 22.30	„
Runnell's Bridge,	10.50	„	„ „ 10.96	„ (Nashua Mfg. Co.)
	66.75	„	„ „ 68.51	

10¼ hour power.

Nashua: power fully developed in a very thorough and substantial manner; product, cotton flannels and blankets. Jackson: product, shirtings and cotton flannels. Runnell's Bridge used for storage only, but could be for power if desired.

Watershed: typical New England.

Coal: $4.46 per short ton.

Steam used at Nashua for manufacturing or other purposes.

Water used at Nashua for other purposes than for power.

Wheels installed:

Nashua, 8-5-39-inch; 2-36-inch; 1-66-inch; 3 605 HP. at 75 per cent. efficiency.

Jackson, 5-4-72-inch; 1-30-inch; 1 520 HP. at 75 per cent. efficiency.

Total steam power development:

Nashua, 2 200 HP. nominal; 3 225 maximum.

Jackson, 700 HP.

Total power required to run mill: Nashua, 3 000 maximum.
Jackson, 1 300 „

Nearly full amount of steam required to run mill.

Approximate area of mill pond: Runnell's Bridge, 63 acres.

Approximate depth to which pond can be drawn: 4 feet in times of low flow.

585 000 cubic feet of storage reservoirs upon watershed.

Storage controlled so as to be drawn in times of low flow.

Controlling factor in award: desire for amicable settlement.

Award included allowance for rearrangement and addition to steam plants.

NASHUA MANUFACTURING COMPANY, $33.60; JACKSON COMPANY, $58.00, PER SQUARE MILE PER FOOT OF FALL.

146 New Hampshire, Nashua, 1900.
Metropolitan Water Board (of Massachusetts) to City of Nashua, N. H.
NO POWER.
Authority: A. W. Dean, Nashua, N. H.
BY AWARD, $29 000 (exclusive of interest).
Sewage disposal in Nashua River.
Watershed above privilege: 528 square miles.
Watershed taken: 118 square miles.
Insufficient amount of water flowing in river to properly dilute sewage from city. Amount of award based upon cost of construction of intercepting sewers.
SPECIAL DAMAGES.

147 New Hampshire, Tilton, Laconia, and Guilford, July 1, 1889.
William A. Russell, of Lawrence, Mass., and Warren F. Daniels, Franklin, N. H., from Proprietors of Locks and Canals on Merrimac River, Lowell, Mass., and The Essex Company, Lawrence, Mass.
FULLY DEVELOPED PRIVILEGE WITH MILL PROPERTY ON OUTLET OF LAKE WINNEPISSIOGEE.
Authority: W. E. Buck, Worcester, Mass.
SALE, $85 000 (exclusive of interest).
Sold all the stock of Winnepissiogee Lake Cotton and Woolen Manufacturing Company. (See also remarks below.)
Total area of watershed above Lakeport dam: 366 square miles; above East Tilton dam, 428 square miles.
Fall used at East Tilton, 16 feet; at Lakeport, 8 to 12 feet.
12 and 24 hour power.
Watershed: hilly and wooded.
Approximate area of mill pond above Lakeport dam: 71¾ square miles; above East Tilton, 7½ square miles.
Available storage depth at Lake Winnepissiogee: 4 feet; Lake Winnisquam (East Tilton), 2 feet.
Storage reservoirs: Smith's and Crooked ponds, 4.85 square miles.
Control of storage very good.
This sale included all property of the Lake Company, and in addition to the above-named water power it included the following:

An interest in one water power at Tilton, N. H., worth	$5 000
An interest in Perley Canal at Laconia, N. H., worth	5 000
Land and buildings at the Weirs, N. H., worth about	4 000

The dam at East Tilton, N. H., is at the outlet of Lake Winnisquam and controls the flow of the Winnepissiogee River from this point

down. The head is about 16 feet, and the Lake Company are under agreement with mill owners below to discharge not less than 250 c.f.p.s. on 24 hour schedule at all times, and control the flow over and above this amount. This power at time of sale was leased and in use for a ground wood-pulp mill, the Lake Company reserving the right to control the flow of water subject to the above requirement.

The dam at Lakeport controls the outlet of Lake Winnepissiogee, and the Lake Company are under agreement with the Laconia mill owners which requires a constant flow of about 250 c.f.p.s. at this point. Here and at Laconia the water is largely used on 10 hour schedule and can be used on either 10 hour or 24 hour schedule at either place without serious trouble, as there is a mill pond above the Laconia dam of 445 acres. The power at Lakeport is subject to two perpetual leases, and aside from these was in use at time of sale to run one hosiery mill, one saw mill, one grist mill, and two small cotton mills, all included in the sale.

$6.75 PER SQUARE MILE PER FOOT OF FALL.

148 New Hampshire, Wolfboro, January 2, 1889.

The Winnepissiogee Lake Cotton and Woolen Manufacturing Company to Nathaniel T. Brewster and James H. Martin of Wolfboro, N. H.

DEVELOPED WATER PRIVILEGE, OUTLET OF SMITH'S AND CROOKED PONDS.

Authority: W. E. Buck, Worcester, Mass.

SALE, $6 000 (exclusive of interest).

Watershed diverted: 24 square miles.
Fall: about 18 feet when dam is full.
Very little fall used or developed.
Character of watershed: rather flat and open.
Approximate area of mill pond: 4.85 square miles.
Working depth of mill pond: 4 feet.
Storage reservoirs upon watershed: Smith's and Crooked ponds only.
Control of storage: good.
Power variable with height of water in lake, but could probably rely on head of 14 feet with flow of about 25 c.f.p.s. for 24 hours.

$13.87 PER SQUARE MILE PER FOOT OF FALL.

149 New York, Bedford, Westchester County, 1906.

Seth Hoyt *v.* City of New York.

DEVELOPED WATER PRIVILEGE.

Authority: G. G. Honness, Pleasantville Station, N. Y.

BY AWARD, $64 000 (exclusive of interest).

Award,	**$64 000**
Disbursements,	**1 512**
Counsel fees,	**3 215**
Interest,	**4 304**
Total,	**$73 031**

Character of privilege: grist and saw mill.

Area of watershed: 28.09 square miles.

Watershed diverted: 2.54 square miles of watershed was acquired for reservoir purposes, and this eliminated this power.

Water diverted:

Average run-off per square mile, 32-year record = 1.698 c.f.p.s.
„ driest year, „ „ = 0.93 „
„ wettest „ „ „ = 2.60 „

Fall developed: 22.5 feet out of 32.5 feet.

10 hour power when used as grist mill.

Character of development: grist and saw mill. Of late years feed only was ground. The mill was equipped for the roller flour process. At one time did a wheat-grinding business.

Character of watershed: rolling country devoted to agriculture; not much timber land within drainage area.

Cost of coal:

Anthracite, $6.50 to $7.10 per ton.
Soft coal, 3.75 „ 4.25 „ „

Electric current from hydraulic plant 6 miles to the north: 10 cents per kilowatt hour.

Wheels installed:

Grist mill { One 22 inch Alcott. / „ 24 „ Chapman. / „ 18 „ „ }
Saw mill { One 18-inch Chapman. / „ 48 „ Flutter. / „ Rose wheel. }

Power required to run mill:

Average run-off for 32-year period = 122 HP. theo.
„ driest „ = 67 „ „
„ wettest „ = 187 „ „

Area of pond: 2.1 acres.

Working depth: 5.2 feet.

Storage reservoirs: four natural lakes or ponds.

Award included five buildings, the machinery in the mills, and 9.48 acres of ground.

This power was taken by Commissioners of Appraisal in the Cross River Reservoir Proceedings. Awards made by such commissioners for land, etc., taken by the City of New York are notoriously high. Land taken in these proceedings cost the city over $1 000 per acre. The average assessment before the city acquired it was not over $50 per acre. D. S. Brinsmade valued the power alone at $18 000

to $20,000. A fair value for everything would be perhaps $32 000. The $1 000 per acre noted includes all expenses incidental to taking the land, such as fees for claimants' lawyers, witnesses, etc., and commissioners' fees, and legal expenses of the corporation counsel, etc.

$70.00 PER SQUARE MILE PER FOOT OF FALL.

150 New York, Brunswick, Rensselaer County.
City of Troy *v.* Planters' Hoe Company.
PARTIALLY DEVELOPED WATER PRIVILEGE ON "QUACKENKILL" STREAM.
Authority: E. L. Grimes, Troy, N. Y.
BY AWARD, $24 000 (exclusive of interest).

Character of privilege: brick mill, timber dam, used for the manufacture of planters' hoes. (Business at this time was small and decreasing.)
Watershed above privilege: 81 square miles.
Watershed diverted: 17½ square miles.
Amount of water diverted: all from watershed.
Fall: 29 feet, fully developed.
Ordinarily 10 hour power.
Character of watershed: mountainous.
One wheel, 220 HP.; no steam used.
Area of mill pond: small and of no practical use as storage.
Small storage reservoirs upon watershed.
This property, it is said, could have been bought only a year or two before the city took the water for $10 000 for the whole privilege; the city only diverted about one fifth of the water. The company continued business for a year or two after the award was made and then gave up business. The buildings were getting rather poor. This privilege is located on the "Quackenkill" stream. Other cases on the same stream are now being tried under another commission.

$47.25 PER SQUARE MILE PER FOOT OF FALL.

151 New York, Brunswick, Rensselaer County.
City of Troy *v.* J. T. Young and others.
UNDEVELOPED WATER PRIVILEGE ON QUACKENKILL CREEK.
Authority: E. L. Grimes, Troy, N. Y.
BY AGREEMENT, $6 000.

Area of watershed: 91.3 square miles.
Watershed taken: 17.5 miles.
Fall: 55.1 feet.

Character of watershed: mountainous.
To improve privilege: J. T. Young's and J. A. Clipperly's privileges should be developed together; own only a part of stream, therefore would necessitate purchase of others' rights to about one fourth of stream; would take a long tunnel and power house. No estimate as to cost of development.
Capacity of storage reservoirs: about 58 000 000 cubic feet.
Character of control of storage: controlled by other parties, who use it at privileges below these powers and draw the storage when they need it, regardless of intervening privilege.
Controlling factors in award: value for power purposes; also value of water to farmer for domestic purposes.
In a rocky gorge; would not, however, be very expensive to develop.
$6.23 PER SQUARE MILE PER FOOT OF FALL.

152 New York, Brunswick, Rensselaer County.
City of Troy *v.* J. A. Clipperly and others.
UNDEVELOPED WATER PRIVILEGE ON QUACKENKILL CREEK.
Authority: E. L. Grimes, Troy, N. Y.
BY AGREEMENT, $1 000.
Watershed above privilege: 91.3 square miles.
Watershed taken: 17.5 square miles.
Fall: 10.6 feet.
Character of watershed: mountainous.
To improve privilege: this privilege and J. T. Young's should be developed together; own only part of stream, therefore would necessitate purchase of others' rights to about one fourth of stream; would take long tunnel and a power house. No estimate as to cost of development.
Storage capacity: 58 000 000 cubic feet.
Character of control of storage: controlled by other parties, who use it at privileges below these powers and draw the storage when they need it regardless of intervening privilege.
Controlling factors in award: value for power purposes; also value of water to farmer for domestic purposes.
In a rocky gorge; would not, however, be very expensive to develop.
$5.40 PER SQUARE MILE PER FOOT OF FALL.

153 New York, Brunswick, Rensselaer County.
City of Troy *v.* Francis Collison.
DEVELOPED WATER PRIVILEGE ON QUACKENKILL CREEK.
Authority: E. L. Grimes, Troy, N. Y.
BY AGREEMENT, $2 750 (exclusive of interest).

Watershed above privilege: 25.3 square miles.
Water taken: 17.5 square miles.
Fall: 3 feet.
Power used only occasionally for turning grindstone, pumping water for domestic purposes, threshing, etc.
Character of development: small wooden dam. Turbine water wheel with small shed over.
Character of watershed: mountainous.
Water is used for power and domestic use.
One 7 HP. wheel installed.
Privilege is in fairly good condition of repair.
Storage reservoirs upon watershed: about 58 000 000 cubic feet.
Character of control of storage: controlled by other parties, who use it at privileges below these powers and draw the storage when they need it, regardless of intervening privilege.
Controlling factors in award: value for power purposes; also value of water to farmer for domestic purposes.
Is a plant used by a prosperous farmer for uses on his farm to furnish water and power for grindstone, threshers, etc.

$52.38 PER SQUARE MILE PER FOOT OF FALL.

154 New York, Brunswick, Rensselaer County.
City of Troy, *v.* Willard D. Green.
UNDEVELOPED WATER PRIVILEGE ON QUACKENKILL CREEK.
Authority: E. L. Grimes, Troy, N. Y.
BY AGREEMENT, $1 350.

Watershed above privilege: 18.1 square miles.
Watershed taken: 17.5 square miles.
Water taken: total flow from area diverted, 17.5 square miles.
Fall: 74 feet.
Character of watershed: mountainous.
To improve privilege: dam must be built, conduit about ¼ mile in length, and power plant.
Storage reservoirs about 58 000 000 cubic feet capacity.
Storage controlled by other parties, who used it at privileges below these powers and draw the storage when they need it, regardless of intervening privilege.
Controlling factor in award: prospective value for power purposes.
No allowances for other than water or water power.
Remarks: formerly developed in three separate plants. Dams now all destroyed and power plants entirely obliterated. Cost of development would be large in proportion to amount of power that could be obtained.

$1.04 PER SQUARE MILE PER FOOT OF FALL.

155 New York, Fort Plain, 1899 to 1906.

Fred Loeffler Estate, Morey, Miller, and Yoran *v.* Fort Plain, N. Y.

DEVELOPED WATER POWER PRIVILEGE ON NORTH CREEK (tributary of Garoga Creek).

Authority: Robert E. Horton, Albany, N. Y.

BY AGREEMENT, 1896, Fred Loeffler Estate, $1 000.

BY AWARD, 1897, Frank Morey, $1 350.
Irving Miller, $1 350
L. Yoran, $1 350.

Character of privilege: Loeffler, Morey, Miller, and Yoran were developed water powers, the first-named being a grist mill and the other three, straw-board mills with cheap dams, wooden buildings, old-fashioned machinery, making air-dried board, a few tons per day.

Area of watershed: about 81 square miles. Area of creek above intake: about 4.65 square miles.

Water diverted: approximately 558 800 gallons.

Fall: 18 to 20 feet.

10 hour working day.

Character of watershed: upper drainage area contains lakes artificially regulated. Stream is good water yielder; moderately rolling in topography and with considerable percentage forest; minimum monthly flow about 30 c.f.s.

Wheels installed: existing paper mills usually have from one to three wheels of an average of perhaps from 25 to 40 HP. each.

Area of mill pond: few acres.

Working depth: usually from 1 to 3 feet.

"Several other owners of property on Garoga Creek and on North Creek were paid either as a result of agreement or condemnation proceedings." These payments were chiefly for rights-of-way and for the diversion of water used solely for farming purposes, and the details of these other payments are not sufficiently well known to be of value. "There were no cases where there were any mills in actual" operation or dams constructed except as above stated.

$57.20 PER SQUARE MILE PER FOOT OF FALL.

156 New York, Frankfort, Herkimer County, February, 1905.

Parker & Waterbury *v.* Utica & Mohawk Valley Railroad Company.

DEVELOPED WATER PRIVILEGE.

Authority: Robert E. Horton, Albany, N. Y.

BY AWARD: About $960 (including interest and allowances for collateral items).

Character of privilege: spring in side of sandy hill; outflow pipe to residences in village 400 feet distant. Water supply used by gravity for household, stable, and lawn purposes of the two claimants.

Total watershed: construction of railway cut drained springs to lower level and cut off pipe line.

Water taken: minimum gaged flow of springs 2 500 gallons per 24 hours.

Fall: about 20 feet fall from springs to ground level at residences. Value of water claimed for domestic uses and not for power.

Controlling factors in award: quality, permanence, and convenience of the water supply, and capitalized cost of substituting municipal village supply in place thereof.

SPECIAL CASE. HOUSEHOLD WATER SUPPLY.

157 New York, Lewisboro, Westchester County, 1906.
George Ruscoe *v.* City of New York.
DEVELOPED WATER PRIVILEGE.
Authority: G. G. Honness, Pleasantville Station, N. Y.
BY AWARD, $9 000 (exclusive of interest).

Award,	**$9 000**
Disbursements,	**268**
Counsel fees,	**450**
Cost,	**50**
Total,	**$9 768**

Character of privilege: cider mill and saw mill.

Area of watershed: 3.72 square miles.

Watershed diverted: only a small portion above this power, but the taking eliminated this power entirely.

Water diverted:

Average run-off, 32-year record = 1.698 c.f.p.s. per square mile.
„ driest „ „ = 0.93 „ „ „ „
„ wettest „ „ = 2.60 „ „ „ „

Fall taken: 7.8 feet out of 7.8 feet.

Mill had not been in use for at least fifteen years.

Character of development: cider and saw mill. Has not been in use of recent years.

Character of watershed: rolling country, devoted to agriculture. Not much timber within the drainage area.

Cost of coal: Anthracite, $6.50 to $7.10 per ton.
Soft coal, $3.75 „ 4.25 „ „

Electric current from hydraulic plant, 6 miles north, 10 cents per kilowatt hour.

One overshot wheel.

Power of wheels: average run-off with H noted would give 5.6 theoretical HP.

Area of mill pond: very small. Mill had to depend almost entirely on stream flow. Capacity of pond (available), 91 500 gallons.

Award included 4 buildings and machinery in mill and 1.42 acres of land.

This power was taken by Commissioners of Appraisal in the Cross River Reservoir proceedings. Awards made by such commissions for land, etc., taken by the city of New York are notoriously high. Land taken in these proceedings cost the city over $1 000 per acre. The average assessment before the city acquired it was not over $50 per acre. Daniel S. Brinsmade valued the power alone at $18 000 to $20 000. A fair value would be perhaps $32 000. The $1 000 per acre noted includes all expenses incidental to taking the land, such as fees for claimants, lawyers, witnesses, etc., and commissioners' fees and legal expenses of the corporation counsel, etc.

$311.00 PER SQUARE MILE PER FOOT OF FALL.

158 New York, Lewisboro, Westchester County, 1906.
George Hull Estate *v.* City of New York.
DEVELOPED WATER PRIVILEGE.
Authority: G. G. Honness, Pleasantville Station, N. Y.
BY AWARD, $18 000 (exclusive of interest).

At least 20 per cent. to be added to amount of award.

Grist and saw mill.

Watershed above privilege: 16.5 square miles.

Watershed diverted: power entirely eliminated.

Water diverted:

Average run-off per square mile, 32-year record = 1.698 c.f.p.s. per square mile.

Average run-off driest year, 32-year record = 0.93 c.f.p.s. per square mile.

Average run-off wettest year, 32-year record = 2.60 c.f.p.s. per square mile.

Fall: 11.5± feet.

Fall used: 11.5± feet.

10 hour power.

Character of development: feed and a small quantity of sawed lumber.

Character of watershed: rolling country devoted to agriculture; not much timber within drainage area.

Cost of coal: Anthracite, $6.50 to $7.10 per ton.
Soft coal, 3.75 „ 4.25 „ „

Electric current from hydraulic plant six miles north, 10 cents per kilowatt hour.
Wheels installed: 2 turbine wheels.
1 rose wheel.
1 flutter wheel.
Area of pond: 1.75 acres.
Working depth of pond: 6.2 feet. Storage available, 1 300 000 gallons.
Storage reservoirs: 4 natural lakes or ponds.
Award included three buildings and some land.
This power was taken by Commissioners of Appraisal in the Cross River Reservoir proceedings. Awards made by such commissions for land, etc., taken by the city of New York are notoriously high. Land taken in these proceedings cost the city over $1 000 per acre. The average assessment before the city acquired it was not over $50 per acre. Daniel S. Brinsmade valued the power alone at $18 000 to $20 000. A fair value would be, perhaps, $32 000. The $1 000 per acre noted includes all expenses incidental to taking the land, such as fees for claimants' lawyers, witnesses, etc., and commissioners' fees and legal expenses of the corporation counsel, etc.

$94.70 PER SQUARE MILE PER FOOT OF FALL.

159 New York, Little Falls, 1899 to 1902.

Various millers on Spruce Creek against City of Little Falls.

DEVELOPED WATER PRIVILEGE ON SPRUCE CREEK (tributary to East Canada Creek near Dolgeville, N. Y.).

Authority: Robert E. Horton, Albany, N. Y.

SMALL AMOUNTS (a few hundred dollars each) to several small mills.

Character of privileges: small grist and saw mills and wood-working establishments.
Total area of watershed: above Little Falls, city intake and storage dam, 36.2 square miles; above mouth, 50.4 square miles.
Usually 10 hour power used; for custom saw and grist mills it was frequently less.
Character of watershed: rolling highland, partly in cultivation, but containing large percentage of forest and swamp land. Rainfall about 40 inches per annum. Soil generally impervious, but stream an excellent water yielder.
Usually one or two old-fashioned inefficient wheels of small power.
Area of mill pond: slight.
Working depth of mill pond: 1 or 2 feet.
Storage reservoirs not on watershed at time of diversion.

City built water-works conduit intended to deliver about 4 000 000 gallons per day; also a storage reservoir of 150 000 000 gallons capacity at Salisbury, the intention being to use this as compensation reservoir and let out in the spring an amount equal to the ordinary low water flow, and also to take therefrom water supply required for city of Little Falls, the conduit being usually operated at full capacity.

(NOTE. — For further description of drainage area, etc., see State Engineer's reports for 1903, page 77.)

"In looking over the reports for the years from 1899 to 1905 I find that the following payments were made. I do not know whether they were settlements of awards. With the exception of McDougal & Elwood and Beardslee, all seem to have been farmers."

1899	J. H. Clemens,	$75.00
	G. W. Smith,	375.00
1900	McDougal, Elwood, Bingham *et al.*,	10 000.00
	E. C. Fairchild,	350.00
	C. R. Avery,	100.00
1901	Louisa Edwards,	200.00
1903	Helen Hughes,	60.00
	Beardslee,	5 500.00*
	Corey and Fish,	350.00
	Shedd, Munder, and six others,	1 865.82
	H. D. Wright, attorney for several cases,	1 450.00
1905	H. D. Wright, attorney for fifteen cases,	3 733.13

DATA INCOMPLETE.

160 New York, Olive Bridge, Ulster County, March, 1908.

Ferdinand Ehrlich *v.* Board of Water Supply, City of New York.

UNDEVELOPED WATER PRIVILEGE ON ESOPUS CREEK.

Authority: Robert E. Horton, Albany, N. Y.

NO DAMAGE.

Character of privilege: undeveloped fall, chiefly in natural waterfall in shale rock gorge.

Total watershed: about 235 square miles.

Fall: 24 feet.

Character of watershed: Precipitous, largely forest covered. A very torrential stream, minimum flow about 20 c.f.s.

Controlling factors in award: claimant asked $300 000 to $500 000 award on assumption of clear title to entire fall and in view of fact that in conjunction with property and adjacent thereto is available blue stone aggregating millions of dollars in value,

* And 3½ inches water over 18-foot weir.

which can be economically quarried and milled by water power. Commission did not uphold claimant's title and adjudged no value for any water power which he owned.

City proposed to build Ashokan dam at this site to divert practically entire drainage area and flow.

(NOTE.—For further description of drainage area, etc., see State Engineer's Report for 1903, page 132; also in later reports.)

NO DAMAGE.

161 New York, Ithaca, Tompkins County.

UNDEVELOPED WATER PRIVILEGE ON TAUGHANNOCK CREEK.

Authority: Leonard Metcalf, Boston, Mass.

AWARD, $80 000.

Watershed: 67 square miles.

Fall: 543 feet.

$2.21 PER SQUARE MILE PER FOOT OF FALL.

162 New York, Pittstown, Rensselaer County.

City of Troy *v.* William Yates.

DEVELOPED WATER PRIVILEGE ON TOMHANNOCK CREEK.

Authority: E. L. Grimes, Troy, N. Y.

BY AWARD, $3 200 (exclusive of interest).
$3 770.72 (including interest, etc.).

Saw mill.

Watershed above privilege: 1¾ square miles.

Watershed diverted: 1¾ square miles.

Water taken: entire flow of stream.

Fall: 20 feet.

10 hour power, more or less, as custom work demands.

Character of development: earth dam and small mill, 15-inch McCormick wheel, sawed about 300 000 feet BM. per annum.

Character of watershed: upper third mountainous and well wooded; lower two thirds open and hilly, or rolling and largely cultivated, or pasture land.

One wheel installed.

Area of mill pond: small and not capable of storing sufficient water to run mill for several hours.

Award included allowance for land and houses: 2.2 acres of land, but no other buildings.

The earth dam had been washed out the year before the city condemned it. The mill was old and not in very good repair.

$91.43 PER SQUARE MILE PER FOOT OF FALL, including land and houses.

163 New York, Pittstown, Rensselaer County.

City of Troy, *v.* Hiram File.

DEVELOPED WATER PRIVILEGE ON TOMHANNOCK CREEK.

Authority: E. L. Grimes, Troy, N. Y.

BY AWARD, $17 000 (exclusive of interest).
$20 031.95 (including interest, etc.).

Saw and grist mill.

Watershed above privilege: 10 square miles.

Watershed diverted: 10 square miles.

Water taken: entire flow of stream.

Fall: 24 feet.

Fall developed: 24 feet.

10 hour power used more or less, as work demands.

Character of development: rubble masonry dam, two separate mills, wooden penstock to each; saw mill from 50 000 to 400 000 feet sawed timber per annum. Grist mill custom grinding.

Character of watershed: upper third mountainous and well wooded; lower two thirds open and hilly or rolling and largely cultivated or pasture land.

Two wheels installed, one in each mill; no steam used.

Area of mill pond: small and not capable of storing sufficient water to run mill for several hours.

Award included allowance for land and houses: 34 acres of land, a large house, and a tenement house, all in good repair.

Privilege was located within the site of the city's proposed reservoir and all the property was in very good condition.

Did considerable grist mill and saw business. Located in small villages and in good farming district.

$70.80 PER SQUARE MILE PER FOOT OF FALL, *including* land and houses.

164 New York, Rochester, Counties of Monroe, Livingston, and Ontario; award, 1886; settlement, 1892–5.

City of Rochester, County of Monroe, N. Y., 25 owners of water rights, old conduit; 23 owners of water rights, new conduit.

DEVELOPED WATER PRIVILEGES UPON HEMLOCK AND CANADICE LAKES.

Authority: E. A. Fisher, Rochester, N. Y.

BY AWARD, exclusive of interest, $111 123.64; including interest and costs $123 376.98 (account of old conduit, 9 000 000 gallons per day from Hemlock Lake, June 17, 1886).

BY AGREEMENT, exclusive of interest, $67 250 (account of new conduit, remainder, about 20 000 000 gallons per day from both lakes).

Character of privilege: saw mills, flour mills, wood working mills, paper mills, cider mills, and machine shops.

Watershed above privilege: 129 466 acres = 202.29 square miles.

Watershed diverted: 39 952 acres = 62.42 square miles.

Water diverted: first, old conduit, 9 000 000 gallons per day; second, whole flow of both lakes, exclusive of 9 000 000 gallons already taken, about 20 000 000 gallons per day additional. (See table attached.)

10 hour power generally used.

Character of development: lumber, flour, wood working, paper, and cider mills, machine shops, factories, etc.

Character of watershed: hilly.

Coal estimated at $3.50 per ton, first award.

Electric current not used at that time.

Steam is used to some extent.

Water is now used for municipal purposes entirely.

Storage upon watershed: there are two lakes upon the watershed; Hemlock Lake, about 7 miles long, having an area of about 3 square miles, and Canadice Lake, about 3 miles long, having an area of about 1 square mile.

Character of control of storage: originally by digging out channel of Hemlock Lake when water was low.

Controlling factor in award: reduction of water supply required installation of steam power.

The proceedings in the matter of the application of the city of Rochester to acquire the permanent and perpetual right to draw from Hemlock and Canadice lakes an amount of water for the use of said city and its inhabitants not exceeding 9 000 000 of gallons per day, referred to herein as the *old conduit, — 9 000 000 gallons per day,* — were very long drawn out, and the matter of damage to mill owners was gone into very thoroughly by the late Mr. J. Nelson Tubbs and by Mr. Emil Kuichling. The printed proceedings in the Court of Appeals cover about 1 300 pages. It is difficult, however, to collect out of this vast amount of material definite statements that will answer the questions herein. (See table attached.)

$43.50 PER MILLION GALLONS DAILY PER FOOT OF FALL, first diversion.

$11.90 PER MILLION GALLONS DAILY PER FOOT OF FALL, second diversion.

STATEMENT GIVING NAMES OF OWNERS OF WATER-POWER RIGHTS ON HEMLOCK LAKE OUTLET AND HONEOYE CREEK, ETC.

Name of Owner.	Kind of Right.	Wheels. No.	Wheels. Diameter in Inches.	Wheels. Class.	Effective Head in Feet.	Cubic Feet per Minute Required to Operate Wheels to Full Capacity.
Salsich & Ruland	2d	1	30½	Leffel	12	1 204
Barton & Williams	1st	1	30½	Leffel	17½	1 453
J. W. Townsend	1st	2	55 } 36 }	Bodine } Risdon }	7½	4 061
Cora J. Trimmer	1st	1	36	American	14	1 459
Amos Lotee	1st	2	23 } 35 }	Leffel	10½	2 133
Frank A. Booth	1st	1	30½	Leffel	18	1 475
Davis & Fairchild	2d	1	24	York	13½	800
James A. Stillman	57% of 3d	1	28	York	13	1 057
Eunice A. Lloyd	43% of 3d	1	24	Leffel	13	785
Edwin E. Bond	2d	2	40 } *30½ }	Leffel	12	3 287
Lewis Johnson or J. Ideson	3d	1	30½	Leffel	10	1 099
John Ideson	1st	2	42 } 30 }	Tait	14	3 753
W. R. & E. L. Yorks	1st	1	Breast	wheel	6	1 714
George R. Smith	1st	2	†30½ 20 ft.	Leffel } Overshot }	22	1 667
Smith & Johnson	2d	2	30½ } 17½ }	Leffel	22	2 163
M. & S. Pierce	2d	1	26½	Leffel	16	1 043
Smith & Pride	1st	2	35 } 35 }	Leffel	16	3 662
Hunt Brothers	1st	2	30½	Leffel	11	1 153
Lee & Cook	1st	2	30 } 30 }	Greig } Tait }	10½	2 266
Weaver & Foote	1st	1	48	Leffel	9½	2 677
B. G. Weaver	2d	1	30	American	9½	905
J. W. Day	1st	2	60 } 60 }	Nelson	6	7 894

165 New York, Rome, 1903 and 1904.

Whitestown Water Company *v.* City of Rome, N. Y.

UNDEVELOPED WATER PRIVILEGE ON EAST BRANCH OF FISH CREEK BETWEEN TABERG AND POINT ROCK, N. Y.

Authority: Robert E. Horton, Albany, N. Y.

* Bond's wheel given as 30½ inches is really 26½ inch special, but uses the same amount of water as a 30½-inch wheel.

† George R. Smith's wheel is a 30½ inch special.

BY AWARD, $7 200 (including value of farm land).

Character of privilege: undeveloped fall in rock gorge.

Total watershed: 135 square miles.

Watershed diverted: City of Rome appropriated Chism farm fronting on creek, thus dividing fall on claimant's property. City had acquired right from legislature to divert water, bed of stream being included in an Indian reservation, but right to use water belonged to owners of water frontage, except as required by state for public purposes.

Water diverted: actual amount did not enter question. Population supplied about 15 000, but city assumed right to take entire minimum flow of 30 000 000 gallons per twenty-four hours.

Fall: 273 feet.

Character of watershed: southwestern Adirondack slope, largely forest covered, much swamp area. Precipitation, 50 inches or 60 inches per year.

Coal about $2.60 per ton in adjacent cities.

Power development: proposed 2 500 HP.

Supplementary steam or electricity necessary; proposed by claimant, but excluded from testimony by commission.

Development requires dam 55 feet high in rock gorge, about 100 feet wide; also conduit 18 140 feet long.

Proposed dam would give pondage area of a few acres.

It was assumed pond would be drawn several feet.

Controlling factors in award: claimant owns lands bordering streams opposite which there was a total fall of 273 feet. City appropriated one parcel for purpose of building intake. Fall below this parcel, 111 feet. Claimant estimated value of property as a single unit at various rates as high as $700 000. He claimed that what was left below city's appropriation was worthless for development; that value of upper fall alone (162 feet) was only $200 000 or $300 000, leaving estimated damage of several hundred thousand dollars, amounts varying according to different experts. City's experts, including writer, estimated none of the power to be of any value for immediate development. I estimated its present worth undeveloped, assuming that it would be profitable for development in ten of fifteen years, to be $7 200, which amount was awarded by commission.

$0.20 PER SQUARE MILE PER FOOT OF FALL.

¶

166 New York, Saranac Lake, 1902.

Benjamin Hall *v.* State of New York.

DEVELOPED WATER PRIVILEGE ON SARANAC RIVER, N. Y.

Authority: Robert E. Horton, Albany, N. Y.

Claimant adjudged not having any water power of value.

Character of privilege: 8 feet head created by dam giving large storage and controlling lake.
Area of watershed: 157.5 square miles.
Character of watershed: eastern Adirondack forest. Rainfall, 30 inches to 36 inches; run-off regulated by lakes.
Area Saranac Lake: 14.5 square miles.
Controlling factors in award: State Court of Claims on several trials gave claimant awards, but each time case was sent back for re-trial on the ground of award not being in accordance with facts in evidence and without proper legal foundation; that state had acquired title to whatever land it flooded and that no water power of any value was destroyed. Case was finally dropped.*
Twice sent back for re-trial.

No DAMAGE.

167 New York, Schaghticoke, Rensselaer County.
City of Troy *v.* James Evans.
DEVELOPED WATER PRIVILEGE ON TOMHANNOCK CREEK.
Authority: E. L. Grimes, Troy, N. Y.
BY AWARD, $12 000 (exclusive of interest).
$14 140.20 (inclusive of interest, etc.).

Grist mill.
Watershed above privilege: 69 square miles.
Watershed diverted: 67 square miles.
Fall: 18 feet.
10 hour power more or less, as custom work demands.
Character of development: timber dam, custom grinding only.
Character of watershed: upper one third mountainous and well wooded; lower two thirds open and hilly or rolling and largely cultivated or pasture land.
One wheel installed. No steam.
Area of mill pond: small and not capable of storing sufficient water to run mill for several hours.
Award included damages to dwelling and land connected therewith; small amount of land.
Privilege was located below the city's dam about one mile.
Did a considerable grist and saw mill business.
Located near small villages and in good farming districts.

$13.70 PER SQUARE MILE PER FOOT OF FALL, including damages to land and buildings, and award for No. 168.

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* Award on first trial: land, 59.2 acres at $1.50 acre $88.79
Dam site and water power 2 000.00
Total, plus interest $2 088.79

168 New York, Schaghticoke, Rensselaer County.
City of Troy *v.* George Burton.
DEVELOPED WATER PRIVILEGE ON TOMHANNOCK CREEK. UNUSED.
Authority: E. L. Grimes, Troy, N. Y.
BY AWARD, $4 500 (exclusive of interest).
$5 302.58 (inclusive of interest, etc.).
Saw mill and old flax mill not used for several years.
Watershed above privilege: 69 square miles.
Watershed taken: 67 square miles.
Fall: 18 feet.
Fall used: 18 feet.
10 hour power, more or less, as custom work demands.
Character of development: custom work only; use dam in connection with another mill.
Character of watershed: upper one third mountainous and well wooded; lower two thirds open and hilly or rolling, and largely cultivated or pasture land.
Two wheels installed, one in each mill. No steam.
Area of mill pond: small and not capable of storing sufficient water to run mill for several hours. No storage reservoirs.
Award included damages to dwelling and land connected therewith and small amount of land. Privilege was located below the city's dam about one mile. The old flax mill had not been used for several years before city took water, and sawmill was not in good repair, although they did some custom sawing there.
INCLUDED WITH No. 167.

169 New York, Schaghticoke, Rensselaer County.
City of Troy *v.* Tibbitts Estate.
UNDEVELOPED WATER PRIVILEGE ON TOMHANNOCK CREEK.
Authority: E. L. Grimes, Troy, N. Y.
BY AWARD, $22 000.
Character of privilege: Undeveloped, extends along stream for about two miles.
Watershed above privilege: about 75 square miles.
Watershed taken: 67 square miles.
Water diverted: total flow of stream from watershed diverted.
Fall: 150 feet.
Character of watershed: extreme upper portion mountainous; lower part, or probably five sixths of whole, is hilly, rolling country; about 12½ per cent. wooded.

To improve privilege: dam must be built and long conduit, power plant, etc. No estimate made of cost of development, so far as known.

No storage reservoirs upon watershed.

Controlling factors in award: Prospective value for power purposes, also depriving farm lands adjacent to stream from water.

At some time in the past there were one or two mill powers developed on this property, but the only visible signs of them now are the remains of portions of the end embankments of the dams.

$2.19 PER SQUARE MILE PER FOOT OF FALL.

170 New York, Schaghticoke, Rensselaer County.

City of Troy *v.* Theodore Button.

UNDEVELOPED (BUT EASY TO DEVELOP) WATER PRIVILEGE ON TOMHANNOCK CREEK.

Authority: E. L. Grimes, Troy, N. Y.

BY AWARD, $16 000 (exclusive of interest); including interest, $18 851.06.

Watershed above privilege: about 78 square miles.

Watershed taken: 67 square miles.

Amount of water taken: total flow of stream from watershed.

Fall: 40 feet.

Character of watershed: extreme upper portion mountainous; lower part, or probably five sixths of whole, hilly, rolling country; about 12½ per cent. wooded.

To improve privilege, dam and power plant must be built.

Controlling factors in the award: prospective value for power purposes and damage to farm lands adjacent, caused by loss of water diverted.

This power could be very easily developed. The fall is over a ledge of rock, good foundations for dam and power plant. Fall nearly vertical. Length of dam not over 150 feet. Would have no storage. Power developed would, therefore, fluctuate considerably in amount.

$5.97 PER SQUARE MILE PER FOOT OF FALL.

171 New York, Schaghticoke, Rensselaer County.

City of Troy *v.* M. F. Hoag.

UNDEVELOPED WATER PRIVILEGE ON TOMHANNOCK CREEK.

Authority: E. L. Grimes, Troy, N. Y.

BY AWARD, $1 200.

Watershed above privilege: about 80 square miles.

Watershed taken: 67 square miles.

Amount of water taken: total flow of stream from watershed diverted.
Fall: 8 feet.
Character of watershed: extreme upper portion mountainous; lower part, or probably five sixths of whole, is hilly, rolling country, about 12½ per cent. wooded.
To improve privilege: dam must be built and power plant installed at dam.
Controlling factors in award: prospective value for power purposes and damage to farm adjoining stream occasioned by loss of water diverted.
This power was at one time developed, but only a few visible remains of the old dam exist.

$2.24 PER SQUARE MILE PER FOOT OF FALL.

172 New York, Troy.
City of Troy *v.* James Hislop.
DEVELOPED WATER PRIVILEGE ON POESTENKILL CREEK.*
Authority: E. L. Grimes, Troy, N. Y.
BY AGREEMENT, $5 000.
Watershed above privilege: 96 square miles.
Watershed taken: 17.5 square miles.
Theoretical fall: 12 feet.
Fall used: 12 feet.
10 hour power.
Character of development: timber dam, turbine wheel, power used in foundry.
Character of watershed: mountainous.
One 60-inch Leffel wheel, 12-foot head, installed.
Privilege in fairly good condition of repair.
Capacity of storage reservoirs: 58 000 000 cubic feet.
Character of control: controlled by other parties, who use it at privileges below these powers and draw the storage when they need it, regardless of intervening privilege.
Controlling factors in award: value for power purposes; also value of water to farmer for domestic purposes.
This power is near the mouth of the stream and at high water in the river into which the stream enters the water sets back up the stream, entirely submerging the dam of this power, and the total fall is only available when the river is at its lowest stages. Probably about three months in the year total head is not available.

$23.80 PER SQUARE MILE PER FOOT OF FALL.

* To which the Quackenkill Creek is tributary.

173 New York, Utica, 1902.

William G. Weaver *et al. v.* Consolidated Water Company of Utica, N. Y.

UNDEVELOPED WATER PRIVILEGE ON REELS CREEK (entering Mohawk River from the north at Utica).

Authority: Robert E. Horton, Albany, N. Y.

No award for Water Power. No Damage.

Character of privilege: undeveloped falls and rapids in narrow rocky gorge about four miles in length below water company's intake.

Watershed diverted: referee gave water company right to divert about 5 400 000 gallons per day during months of November to April inclusive, but enjoined company against diversion during summer months; 20-inch cast-iron pipe on grade of 2.84 feet per thousand feet.

Fall taken: farms along stream pooled their interests, except that fall on each farm was assumed to be separately developed by one or more dams.

Name of Dam.	Drainage Area. Square Miles.	Amount of Fall. Total Head. Ft.
No. 1 Johnson,	5.6	17.5
No. 2 „	6.5	19.75
No. 3 „	7.1	17.5
Turnbull,	7.2	8.0
Marsh,	7.3	10.5
Upper Coventry,	7.7	15.5
Wells,	8.2	32.5
No. 2 Coventry,	8.3	25.0
No. 3 Coventry,	9.1	10.5

Character of watershed: pasture land, with steep slopes and numerous wooded gulleys, underlaid by shale rock, very torrential.

Controlling factors in award: claimant assumed that available power could be obtained for manufacture or electrical transmission by constructing dams. Defense successfully overthrew this contention by showing small power available, high cost of development, etc. Referee adjudged the water diverted to be available for agricultural uses only.

(NOTE. — For further description of drainage area, etc., see State Engineer's reports for 1902, page 136; 1903, page 94.)

SPECIAL CASE. NO AWARD.

174 New York, Watertown, August, 1908.

H. Remington & Sons Pulp and Paper Company *v.* Board of Water Commissioners, Watertown, N. Y.

UNDEVELOPED WATER PRIVILEGE one-half mile below village of Black River, Jefferson County, N. Y.

Authority: Robert E. Horton, Albany, N. Y.

NO AWARD, damages being adjudged nominal.

Character of privilege: rapids on limestone rock on Black River comprising about 12 feet fall originally, the upper 8 or 10 feet on land owned on both sides of stream by claimant; also 2 to 4 feet on land owned on one side by claimant, on opposite side by city of Watertown.

Total watershed: about 1 875 square miles.

Character of watershed: western Adirondack slope. Minimum flow 700 to 800 c.f.s., being partially regulated by storage.

Controlling factors in award: referee held that interference or backwater occurred only on portion of stream where city already owned to center of channel, that it was impossible for claimant to develop his half of flow and fall in this portion of river without technical trespass or interference with city's rights, hence damage to him by obstruction of fall by city's dam was adjudged nominal.

Dams built and owned by the city some distance below claimant's property backed water on to the portion of the privilege where claimant owned on one side of river only. Court held that damages, if any, should be awarded on basis of amount of head or fall destroyed at the ordinary stage of stream. This was agreed upon by both parties in case to correspond to flow of 2 300 to 2 500 c.f.s. An amount of interference for this flow was estimated by claimant at 4.2 feet, and by writer, for defendant, at 2.17 feet. Power in question was undeveloped, but could be used in conjunction with plaintiff's pulp mill and electric plant located a few hundred feet upstream.

(NOTE. — For further description of drainage area, etc., see State Engineer's reports for 1902, page 36; 1906, page 36, supplement.)

NO DAMAGE.

175 North Carolina, Durham, Durham County, 1901.

Geer, Cox & Christian *v.* The Durham Water Company.

DEVELOPED WATER PRIVILEGES.

Authority: Durham (N. C.) Water Company.

BY AWARD, $4 000 (exclusive of interest).

Including interest and allowances, $6 000.

Water rights.

Area of watershed: 8 by 15 miles.
Amount of water diverted: 1 000 000 gallons in twenty-four hours; used by Durham Water Company to supply city.
Fall used: 11 feet at Durham Water Company pump station.
Power used: winter, by water twenty-four hours per day; summer, have run by steam at Durham Water Company's pump station.
Character of development: grist mill.
Character of watershed: principally wood land, sparsely settled.
Coal: $4.50 per 2 000 pounds.
Two wheels installed.
Area of mill pond: 1 mile by 200 feet.
Working depth: about 6 feet.
Controlling factor in award: diverting water from stream for city use.

$364.00 PER MILLION GALLONS DAILY PER FOOT OF FALL.

176 Pennsylvania, Bradford, McKean County, 1906.
City of Bradford *v.* C. A. Douglas.
DEVELOPED WATER PRIVILEGES.
Authority: F. W. Dalrymple, Bayonne, N. J.
BY AWARD, $1 plus court costs. Later Purchase, $15 000.
Grist mill with dam and water power.
Watershed above privilege: 104 square miles.
Watershed taken: 14 square miles.
Water diverted: about 1 500 000 gallons per day.
Fall: 9½ feet.
10 hour power.
Character of development: dam with turbines, grist mill.
Character of watershed: hilly and largely wooded.
Coal: $2.50 per 2 000 pounds.
Two wheels installed.
40 HP. required to run mill.
To improve the privilege an auxiliary steam plant should be put in. Cost, $15 000.
Approximate area of mill pond: 12 acres.
Working depth of mill pond: 4 feet.
The city afterwards bought the mill dam and pond for $15 000 and took out the dam as a nuisance.

AWARD, NOMINAL: PURCHASE, $112.77 PER SQUARE MILE PER FOOT OF FALL, including dam and mill.

177 Pennsylvania, Borough of Media, Delaware County, 1903.
Henry T. Kent *v.* Borough of Media.
PARTIALLY DEVELOPED WATER PRIVILEGE.
Authority: Edward H. Hall, Media, Penn.

BY AWARD,* $7 585.25 (including interest at 6 per cent. from April, 1900).

Character of privilege: right to divert 1 500 000 gallons of water continuously through twenty-four hours.

Watershed above point of diversion: 29.9 square miles. At plaintiff's mills, 33 square miles.

Water to be taken: 1 500 000 gallons in twenty-four hours. Only from 500 000 to 800 000 was being actually diverted at time of trial.

Fall: 25 feet.

Fall used: 23½ feet.

10 hour power.

Character of development: there were two mills, one on each side of creek. West side mill was operated by one 18-inch Rodney Hunt wheel and was a weave mill requiring about 40 HP. Steam was used for washing and dyeing; on the opposite end of the line shaft was a 60 HP. upright engine, which was used when water was low. The east side mill had two 21-inch horizontal Rodney Hunt wheels and 125 to 150 HP. Corliss engine. Steam was required in both mills. Boiler capacity in west side, 80 HP., and in east side, 140 HP. In east side engine and wheels were geared on same shaft and run together. It required about 125 HP. to operate east side mill, which manufactured woolen and worsted.

Coal: $3.50 per 2 240 pounds at boilers, Georges Creek bituminous; hauling from railroad station cost 60 cents per ton.

Steam is used in both mills for washing, dyeing, etc.

A small quantity of water is used for other purposes.

One 18-inch Rodney Hunt horizontal wheel, 50 HP., at 75 per cent. efficiency.

Two 21-inch Rodney Hunt horizontal wheels, 142 HP.

Steam and water power development: 342 HP.

Total power required to run mill: west side, about 40 HP.; east side, about 125 to 140 HP.

Capacity of pond: 6 000 000 gallons on an 18-inch draw.

Working depth of mill pond: 18 inches. No substantial storage.

In my judgment, controlling factor with the jury was rate of interest and cost of producing lost power by steam, the jury being of the opinion that the dam of Kent was sufficient to hold the night flow and discharge it during the ten working hours.

This was a condemnation proceeding, the jury of view awarded $3 500; on the first trial before the court and jury a verdict was had for $11 500. A new trial was awarded, and on the second trial the verdict was for $7 585.25. Of course under our laws, this being a condemnation proceeding, the damage is the

* $6 500 approximately, excluding interest.

difference in the market value before and after the diversion. The experts who fixed the damage for the defense made it about $2 400, based on capitalizing at 6 per cent. the cost of supplying the lost power by steam, the estimate being that the water diverted would give 4.6 HP. on the wheel shaft and that for four and a half months in the year the stream flow would be sufficient to run the wheels and would not be affected by the diversion. Counsel for mill owner claimed that the storage being sufficient to hold the flow, instead of the diversion amounting to 4.6 HP., it would be 2.4 times 4.6 HP., or 11.52 HP.

$173.33 PER MILLION GALLONS DAILY PER FOOT OF FALL.

178 Pennsylvania, Crum Lynn, Delaware County, 1895.
Lee & Longbottom, Crum Lynn Mills *v.* Springfield Water Company.
DEVELOPED PRIVILEGE ON CRUM CREEK.
Authority: J. W. Ledoux, Philadelphia.
BY AWARD, $3 500.

Woolen mill run by vertical Leffel water wheels and Corliss engines.
Watershed diverted upon Crum Creek: 29.5 square miles out of 34.9 square miles.
Developed fall: 13.5 feet out of 13.5 feet.
Pondage: 1 125 000 gallons.
10 hour power.
Average flow million gallons per twenty-four hours, including floods: 38.5.
Available flow per hour, including pondage, but with floods cut off: 18.5 m.g.d.
Continuous horse-power diverted: 3.56.
Horse-power after diversion: 28.2.
Watershed: 40 per cent. wooded; balance, farming land.
Coal: $2.50 per ton (low cost due to nearness of two railroads).
Amount of water diverted: 2 000 000 gallons per twenty-four hours.

$130.00 PER MILLION GALLONS DAILY PER FOOT OF FALL.
$8.50 PER SQUARE MILE PER FOOT OF FALL.

179 Pennsylvania, Springfield, Delaware County, 1904.
Palmers Mill *v.* Springfield Water Company.
PRIVILEGE DEVELOPED ON CRUM CREEK.
Authority: J. W. Ledoux, Philadelphia.
BY SALE, $10 000.

Flour mill run by vertical water wheels and no steam.
Watershed diverted upon Crum Creek: 25 out of 25 square miles.
Developed fall: 10 feet out of 10 feet.

10 hour power.
Watershed: 40 per cent. wooded; balance, farming land.
Coal: $4 per ton.
Private purchase including farm and buildings, having a market value of at least one half of purchase price.

$40.00 PER SQUARE MILE PER FOOT OF FALL, INCLUDING FARM AND BUILDINGS.

Say, $20.00 PER SQUARE MILE PER FOOT OF FALL, EXCLUDING BUILDINGS.

180 Pennsylvania, Springfield, Delaware County, 1895.
Sam Lewis, Lapidea Mills *v.* Springfield Water Company.
ABANDONED PRIVILEGE, CRUM CREEK.
Authority: J. W. Ledoux, Philadelphia.
BY AWARD, $2 700.
Watershed diverted upon Crum Creek: 21.9 square miles out of 33.7 square miles.
Bone mill ruins; not in use for many years.
Developed fall: 11 feet out of 11 feet.
Pondage: 1 900 000 gallons.
Originally 10 hour power.
Average flow million gallons per twenty-four hours, including floods: 37.7.
Available flow, including pondage, but with floods cut off: 20.2 m.g.d.
Continuous horse-power diverted: 2.9.
Horse-power after diversion: 25.1.
Watershed: about 40 per cent. wooded; balance, farming land.
Coal: $2.80 per ton (low cost due to railroad siding).
Amount of water diverted: 2 000 000 gallons per twenty-four hours.

$123.00 PER MILLION GALLONS DAILY PER FOOT OF FALL.

$11.20 PER SQUARE MILE PER FOOT OF FALL.

181 Pennsylvania, Springfield, Delaware County, 1895.
W. S. P. Shields, Avondale Mills *v.* Springfield Water Company.
ABANDONED PRIVILEGE ON CRUM CREEK.
Authority: J. W. Ledoux, Philadelphia.
BY AGREEMENT, $3 500.
Watershed diverted upon Crum Creek: 29.5 square miles out o 33.7 square miles.
Developed fall: 14 feet out of 14 feet.
Pondage: 2 600 000 gallons.

Originally 24 hour power.
Average flow million gallons per twenty-four hours, including floods: 37.1.
Available flow, including pondage, but with floods cut off: 21.5 m.g.d.
Continuous horse-power diverted: 3.69.
Horse-power after diversion: 34.6.
Watershed: 40 per cent. forest; balance, farming land.
Coal: $2.80 per ton (low cost due to railroad siding).
Amount of water diverted: 2 000 000 gallons per twenty-four hours.
Paper mill had been burned for many years.

$8.48 PER SQUARE MILE PER FOOT OF FALL.
$125.00 PER MILLION GALLONS DAILY PER FOOT OF FALL.

182 Pennsylvania, Springfield, Delaware County, 1895.
Albert Lewis, Wallingford Mills *v.* Springfield Water Company.
DEVELOPED PRIVILEGE ON CRUM CREEK.
Authority: J. W. Ledoux, Philadelphia.
BY AWARD, $10 000.
Watershed diverted at Springfield Water Company's plant on Crum Creek: 29.5 square miles.
Drainage area above Wallingford Mills: 31.9 square miles.
Developed fall: 10 feet out of 10 feet.
Textile mill run by vertical Leffel water wheels and Corliss engines.
Pondage: 1 900 000 gallons.
10 hour power.
Average flow million gallons per twenty-four hours, including floods: 35.1.
Available flow, including pondage, but with floods cut off: 19.3 m.g.d.
Continuous horse-power diverted: 2.64.
Horse-power after diversion: 21.4.
Watershed: about 40 per cent. wooded; balance, farm land.
Coal: $3.50 per ton.
Water diverted: 2 000 000 per twenty-four hours.

$33.90 PER SQUARE MILE PER FOOT OF FALL.
$500.00 PER MILLION GALLONS DAILY PER FOOT OF FALL.

183 Rhode Island, Cumberland, Providence County, 1905. (Woonsocket Cases No. 1.)
Valley Falls Company (Albion Mill) *v.* City of Woonsocket.
VERY SUBSTANTIAL AND WELL-DEVELOPED PRIVILEGE, BLACKSTONE RIVER.
Authority: Charles T. Main, Boston.

Watershed diverted: 7.9 square miles out of 429 square miles.
Fall: 12.69 feet.
10 hour power used.
Character of development: well-developed cotton mill.
Character of watershed: variable New England.
Coal: $4.20 per 2 000 pounds.
Steam is used for heating and slashing.
Four wheels installed: 2 Holyoke, 54-inch; 1 Leffel, 52-inch; 1 K. & L., 108-inch.
Power of wheels: 700 HP.
Total steam power: 400 HP.
Total power required: 850 HP.
Area of pond: 30 acres.
Working depth: perhaps 1 foot.

SEE No. 214, "WOONSOCKET CASES." SEPARATE AWARD NOT KNOWN.

184 Rhode Island, Cumberland, Providence County, 1905. (Woonsocket Cases No. 2.)

Lonsdale Company, Ashton, *v.* City of Woonsocket.

SUBSTANTIAL AND WELL-DEVELOPED PRIVILEGE, BLACKSTONE RIVER.

Authority: Charles T. Main, Boston.

Watershed diverted: 7.9 square miles out of 433 square miles.
Fall: 9.50 feet.
10 hour power used.
Character of development: well-developed cotton mill.
Character of watershed: variable New England.
Coal: $4.11 per 2 000 pounds.
Steam is used for heating and slashing.
Water is used for boiler feed purposes.
Four wheels installed: 375 HP.
Total steam: 500 HP.
Total power required: 825 to 850 HP.
Area of pond: 40 acres.
Working depth: 1 foot to 18 inches.

SEE No. 214, "WOONSOCKET CASES."

185 Rhode Island, Lincoln, Providence County, 1905. (Woonsocket Cases No. 3.)

Lonsdale Company, No. 1, *v.* City of Woonsocket.

WELL-DEVELOPED AND VERY SUBSTANTIAL PRIVILEGE, BLACKSTONE RIVER.

Authority: Charles T. Main, Boston.

Watershed diverted: 7.9 square miles out of 441 square miles.
Fall: 23.28 feet.
10 hour power used.
Character of development: well-developed cotton mill.
Character of watershed: variable New England.
Cost of coal: $4.11 per 2 000 pounds.
Steam is used for heating, drying, bleaching, etc.
One pair Hercules wheels installed: 410 HP.
Total development: 500 HP.
Power required: 650 HP.
Area of pond: 100 acres.
Working depth: perhaps 2 feet.

SEE No. 214, "WOONSOCKET CASES." SEPARATE AWARD NOT KNOWN.

186 Rhode Island, Cumberland, Providence County, 1905. (Woonsocket Cases No. 4.)

Lonsdale Company, No. 4 Mill, *v.* City of Woonsocket.

WELL-DEVELOPED PRIVILEGE, BLACKSTONE RIVER.

Authority: Charles T. Main, Boston.

Watershed diverted: 7.9 square miles out of 441 square miles.
Fall: 14.03 feet.
10 hour power used.
Character of development: well-developed cotton mill.
Character of watershed: variable New England.
Coal: $4.11 per 2 000 pounds.
Steam is used for slashing.
Water is used for boiler feed and condenser.
Three wheels installed: 630 HP.
Total power development: 750 HP.
Total power required: 1 250 HP.
Area of mill pond: 180 acres.
Working depth: perhaps 1 foot.

SEE No. 214, "WOONSOCKET CASES." SEPARATE AWARD NOT KNOWN.

187 Rhode Island, Valley Falls, Providence County, 1905. (Woonsocket Cases No. 5.)

Albion Company *v.* City of Woonsocket.

WELL-DEVELOPED PRIVILEGE, BLACKSTONE RIVER.

Authority: Charles T. Main, Boston.

Watershed diverted: 7.9 square miles out of 443 square miles.
Fall: 14 109 feet.

10 hour power used.
Character of development: well-developed cotton mill.
Character of watershed: variable New England.
Six wheels installed: 1 033 HP.
Total power development: over 1 200 HP.
Power required: 1 000 HP.
Area of pond: 215 acres.

SEE No. 214, "WOONSOCKET CASES." SEPARATE AWARD NOT KNOWN.

188 Rhode Island, Central Falls, Providence County, 1905. (Woonsocket Cases No. 6.)

Stafford Company *v.* City of Woonsocket.

WELL-DEVELOPED PRIVILEGE, BLACKSTONE RIVER.

Authority: Charles T. Main, Boston.

Watershed diverted: 7.9 square miles out of 472 square miles.
Fall: 9.787 feet.
Character of development: well-developed cotton mill.
Coal: $4 per 2 000 pounds.
Steam is used for heating purposes.
Four wheels installed: 369 HP.
Total steam development: 91 HP.
Total power required: 425 to 450 HP.
Area of mill pond: 20 acres.
Working depth: perhaps 2 feet.

SEE No. 214, "WOONSOCKET CASES." SEPARATE AWARD NOT KNOWN.

189 Rhode Island, Central Falls, Providence County, 1905. (Woonsocket Cases No. 7.)

Farwell Worsted Company *v.* City of Woonsocket.

WELL-DEVELOPED PRIVILEGE, BLACKSTONE RIVER.

Authority: Charles T. Main, Boston.

Watershed diverted: 7.9 square miles out of 472 square miles.
Fall: 9.787 feet.
10 hour power used.
Character of development: well-developed worsted mill.
Character of watershed: typical New England.
Coal: $4 per 2 000 pounds.
Steam is used for dyeing purposes.
Water is used for dyeing purposes.
Three wheels installed: 169 HP.
Total power: 175 HP.

Power required: 226 HP. plus 75 for electric lights.
Area of pond: 20 acres.
Working depth: 2 feet.

SEE No. 214, "WOONSOCKET CASES." SEPARATE AWARD NOT KNOWN.

190 Rhode Island, Central Falls, Providence County, 1905. (Woonsocket Cases No. 8.)

American Hair Cloth Company *v.* City of Woonsocket.

WELL-DEVELOPED PRIVILEGE, BLACKSTONE RIVER.

Authority: Charles T. Main, Boston.

Watershed diverted: 7.9 square miles out of 472 square miles.
Fall: 9.787 feet.
10 hour power used.
Character of development: well-developed hair-cloth mill.
Character of watershed: typical New England.
Coal: $3.80 per 2 000 pounds.
Steam used for heating and dyeing purposes.
Three wheels installed: 231 HP.
Power required: 100 HP.
Area of pond: 20 acres.
Working depth: 2 feet.

SEE No. 214, "WOONSOCKET CASES." SEPARATE AWARD NOT KNOWN.

191 Rhode Island, Central Falls, Providence County, 1895.

City of Worcester *v.* Stafford Manufacturing Company, Central Falls privilege. (Kettle Brook Cases No. 43.)

DEVELOPED PRIVILEGE ON BLACKSTONE RIVER.

Authority: Charles T. Main, Boston.

BY AWARD, $1 680.

Watershed diverted: 3.856 square miles out of 472.0678 square miles.
Horse-power taken (F. A. McClure, authority):
Petitioner's claim, 8.02.
Defendant's claim, 1.58.
Fall: 10.79 feet.
Character of development: cotton yarns and threads.
Coal: $4.25 per 2 000 pounds.
Steam is used for manufacturing or other purposes.
Water is not used for other purposes than for power.
Four wheels installed: 369 HP.
Total steam and electric power development: 95 HP.
Total power required to run mill: 300 HP.

Approximate area of mill pond: 20 acres.
Approximate depth to which mill pond can be drawn: 2 feet.
This mill is entitled to 135/288 of the flow of the river.

$97.00 PER SQUARE MILE PER FOOT OF FALL = TOTAL FOR 3 MILLS ON THIS PRIVILEGE.

SEE NO. 129, "MASSACHUSETTS, WORCESTER, SUMMARY OF KETTLE BROOK CASES."

192 Rhode Island, Central Falls, Providence County, 1895.
City of Worcester *v.* Pawtucket Hair Cloth Company. (Kettle Brook Cases No. 43.)

DEVELOPED PRIVILEGE ON BLACKSTONE RIVER.

Authority: Charles T. Main, Boston.

BY AWARD, $1 200.

Watershed diverted: 3.856 square miles out of 472.0678 square miles
Horse-power taken (F. A. McClure, authority):
Petitioner's claim, 3.42.
Defendant's claim, 0.78.
Fall: 10.79 feet.
Character of development: hair cloth.
Coal: $3.35 per 2 000 pounds.
Steam is used for manufacturing or other purposes.
Water is used for other purposes than for power.
Three wheels installed: 231 HP.
Total steam and electric power development: 75 HP. electric motor current from Pawtucket Electric Company.
Total power required to run mill: 100 HP.
Approximate area of mill pond: 20 acres.
Approximate depth to which mill pond can be drawn: 2 feet.
This mill is entitled to 60½/288 of the flow of the river.

$97.00 PER SQUARE MILE PER FOOT OF FALL = TOTAL FOR 3 MILLS ON THIS PRIVILEGE.

SEE NO. 129, "MASSACHUSETTS, WORCESTER, SUMMARY OF KETTLE BROOK CASES."

193 Rhode Island, Cumberland, Providence County, 1895.
City of Worcester *v.* Manville privileges. (Kettle Brook Cases No. 39.)

DEVELOPED PRIVILEGE ON BLACKSTONE RIVER.

Authority: Charles T. Main, Boston.

BY AWARD, $7 980.

Watershed diverted: 3.856 square miles out of 426.1515 square miles

Horse-power taken:
Petitioner's claim, 30.55.
Defendant's claim, 6.32.
Fall: 18.818 feet.
Character of development: cotton goods.
Coal: $3.80 per 2 000 pounds.
Steam is used for manufacturing or other purposes.
No water is used for any other purposes than for power.
Six wheels installed, 2 382 HP.
Total steam and electric power development: 2 000 HP.
Total power required to run mill: 2 100 HP.
Approximate area of mill pond: 100 acres.
Approximate depth to which mill pond can be drawn: 1 foot.

$109.80 PER SQUARE MILE PER FOOT OF FALL.

194 Rhode Island, Cumberland, Providence County.
City of Worcester *v.* Lonsdale Company. (*a*) Ashton privilege, (*b*) Lonsdale No. 1, (*c*) Lonsdale No. 4. (Kettle Brook Cases No. 41.)

DEVELOPED PRIVILEGE ON BLACKSTONE RIVER.

Authority: Charles T. Main, Boston.

BY AWARD, $8 400.

Watershed above privilege: Ashton, 433.0313 square miles.
Lonsdale No. 1, 440.8070 „ „
„ No. 4, 440.8070 „ „
Watershed diverted: 3.856 square miles.
Horse-power taken (authority, F. A. McClure):
Petitioner's claim, 7.90, 9.38, and 11.68.
Defendant's claim, 2.64, 5.39, and 2.61.
Fall: Ashton, 10 feet; Lonsdale No. 1, 25.20 feet; Lonsdale No. 4, 15.20 feet.
Character of development: Ashton, muslin and sheets.
Lonsdale 1, cotton goods.
„ 4, „ „
Coal: $3.80 per 2 000 pounds.
Steam is used for manufacturing or other purposes.
No water used for any other purposes than for power.
Number of wheels installed: Ashton, 4, 375 HP.
Lonsdale No. 1, 2, 410 HP.
„ No. 4, 3, 600 HP.
Total steam and electric power development:
Ashton, 500 HP.
Lonsdale No. 1, 500 HP.
„ No. 4, 950 HP.

Total power required to run mill:
Ashton, 625 to 850 HP.
Lonsdale No. 1, 650 HP.
„ No. 4, 1 250 HP.
Approximate area of mill pond: Ashton, 40 acres.
Lonsdale No. 1, 110 „
„ No. 4, 180 „
Approximate area to which mill pond can be drawn:
Ashton, 1 foot to 18 inches.
Lonsdale No. 1, 2 feet.
„ No. 4, 1 foot.
Each of these mills is entitled to one half of the flow of the river.
$86.40 PER SQUARE MILE PER FOOT OF FALL.

195 Rhode Island, Cumberland, Providence County, 1895.
City of Worcester *v.* Valley Falls Company, Albion privilege. (Kettle Brook Cases No. 40.)
DEVELOPED PRIVILEGE ON BLACKSTONE RIVER.
Authority: Charles T. Main, Boston.
BY AWARD, $4 515.
Watershed diverted: 3.856 square miles out of 429.4023 square miles.
Horse-power taken (authority, F. A. McClure):
Petitioner's claim, 21.13.
Defendant's claim, 2.89.
Fall: 13.198 feet.
Character of development: sheetings and shirtings.
Coal: $4 per 2 000 pounds.
Steam is used for manufacturing or other purposes.
Water is not used for any other purposes than for power.
Four wheels installed, 700 HP.
Total steam and electric power development: 600 HP.
Total power required to run mill: 850 HP.
Approximate area of mill pond: 30 acres.
Approximate depth to which mill pond can be drawn: 1 foot.
$88.80 PER SQUARE MILE PER FOOT OF FALL.

196 Rhode Island, Pawtucket, Providence County, 1895.
City of Worcester *v.* Darius L. Goff *et al.*, D. L. & L. B. Goff, Pawtucket privileges. (Kettle Brook Cases No. 45.)
DEVELOPED PRIVILEGE ON BLACKSTONE RIVER.
Authority: Charles T. Main, Boston.

BY AWARD, $3 096.

Watershed diverted: 3.856 square miles out of 472.5161 square miles.
Fall: 17.021 feet.
Character of development: electricity.
Coal: $3.30 per 2 000 pounds.
Steam sold to D. Goff & Sons.
No water used for any other purposes than for power.
Eleven wheels installed, 1 300 HP. for 5 pairs.
Total steam and electric power development: 520 HP.
Total power required to run mill: 1 300 HP.
Approximate area of mill pond: 1 acre.
Approximate depth to which mill pond can be drawn: None.
This mill is entitled to one half of the remainder of the flow of the river, after deducting 1 400 c.f.m., or about 0.04 of the flow.

$92.45 PER SQUARE MILE PER FOOT OF FALL = TOTAL FOR 3 MILLS ON THIS PRIVILEGE.

SEE NO. 129, "MASSACHUSETTS, WORCESTER, SUMMARY OF KETTLE BROOK CASES."

197 Rhode Island, Pawtucket, Providence County, 1895.
City of Worcester *v.* Charles B. Paine *et al.*, Paine & Taylor privilege on Sargent's trench. (Kettle Brook Cases No. 45.)

DEVELOPED PRIVILEGE ON BLACKSTONE RIVER.

Authority: Charles T. Main, Boston.

BY AWARD, $105.

Watershed diverted: 3.856 square miles out of 472.5161 square miles.
Horse-power taken: petitioner's claim, 0.48. (F. A. McClure, authority).
Fall: 10.93 feet.
Character of development: power and room rented to small industries.
Coal: $3.30 per 2 000 pounds.
No water is used for any other purposes than for power.
One wheel installed: 40 HP.
Total power required to run mill: 40 HP.
Approximate area of mill pond: 4 acres.
Approximate depth to which mill pond can be drawn: 2 feet.
This mill is entitled to 1 400 c.f.m., or about 0.04 of the flow of the stream.

$92.45 PER SQUARE MILE PER FOOT OF FALL = TOTAL FOR 3 MILLS ON THIS PRIVILEGE.

SEE NO. 129, "MASSACHUSETTS, WORCESTER, SUMMARY OF KETTLE BROOK CASES."

198 Rhode Island, Pawtucket, Providence County, 1895.

City of Worcester *v.* D. Goff & Sons, Lower Dam privilege, east side. (Kettle Brook Cases No. 45.)

DEVELOPED PRIVILEGE ON BLACKSTONE RIVER.

Authority: Charles T. Main, Boston.

BY AWARD, $2 810.

Watershed diverted: 3.865 square miles out of 472.5161 square miles.

Horse-power taken (authority, F. A. McClure): Petitioner's claim, 26.40; defendant's claim, 7.08.

Fall: 17.021 feet.

Character of development: braids and plushes.

Coal: $3 per 2 000 pounds.

Steam is used for manufacturing or other purposes.

Water is used for other purposes than for power.

Two pairs and one single wheel installed, 701 HP.

No steam or electric power development.

Total power required to run mill: 500 HP.

Approximate area of mill pond: 1 acre.

Approximate depth to which mill pond can be drawn: 2 feet.

This mill is entitled to one half of what remains of the flow of the stream after deducting 1 400 c.f.m., or about 0.04 of the flow.

$92.45 PER SQUARE MILE PER FOOT OF FALL = TOTAL FOR 3 MILLS ON THIS PRIVILEGE.

SEE NO. 129, "MASSACHUSETTS, WORCESTER, SUMMARY OF KETTLE BROOK CASES."

199 Rhode Island, Pawtucket, Providence County, 1895.

City of Worcester *v.* Pawtucket Gas Company. (Kettle Brook Cases No. 44.)

DEVELOPED PRIVILEGE ON BLACKSTONE RIVER.

Authority: Charles T. Main, Boston.

BY AWARD, $367.50.

Watershed diverted: 3.856 square miles out of 472.5161 square miles.

Fall: 7.072 feet.

Horse-power taken (authority, F. A. McClure): Petitioner's claim, 1.70; defendant's claim, 0.39.

Character of development: power and gas.
One wheel installed: power not stated.
Approximate area of mill pond: 4 acres.
Approximate depth to which mill pond can be drawn: 2 feet.
This mill is entitled to 10/64 of the flow of the river.

$82.15 PER SQUARE MILE PER FOOT OF FALL = TOTAL FOR 5 MILLS ON THIS PRIVILEGE.

SEE NO. 129, "MASSACHUSETTS, WORCESTER, SUMMARY OF KETTLE BROOK CASES."

200 Rhode Island, Pawtucket, Providence County, 1895.
City of Worcester *v.* Littlefield Manufacturing Company.
(Kettle Brook Cases No. 44.)
DEVELOPED PRIVILEGE ON BLACKSTONE RIVER.
Authority: Charles T. Main, Boston.
BY AWARD, $336.
Water shed diverted: 3.856 square miles out of 472.5161 square miles.
Horse-power taken (authority, F. A. McClure): Petitioner's claim, 1.70; defendant's claim, 0.29.
Fall: 8 feet.
Character of development: cotton yarns.
Coal: $3.35 per 2 000 pounds.
Steam is used for manufacturing and other purposes.
No water used for any other purposes than for power.
Three wheels installed, 125 HP.
Total steam and electric power development: 150 HP.
Total power required to run mill: 130 HP.
Approximate area of mill pond: 4 acres.
Approximate depth to which mill pond can be drawn: 2 feet.
This mill is entitled to 10/64 of the flow of the river.

$82.15 PER SQUARE MILE PER FOOT OF FALL = TOTAL FOR 5 MILLS ON THIS PRIVILEGE.

SEE NO. 129, "MASSACHUSETTS, WORCESTER, SUMMARY OF KETTLE BROOK CASES."

201 Rhode Island, Pawtucket, Providence County, 1895.
City of Worcester *v.* Job L. Spencer, Old Slater privilege.
(Kettle Brook Cases No. 44.)
DEVELOPED PRIVILEGE ON BLACKSTONE RIVER.
Authority: Charles T. Main, Boston.

BY AWARD, $525.

Watershed diverted: 3.856 square miles out of 472.5161 square miles.
Horse-power taken (F. A. McClure, authority): Petitioner's claim, 2.55; defendant's claim, 0.32.
Fall: 6.50 feet.
Character of development: cotton yarns (mill idle).
Three wheels installed, presumed to be 75 HP.
No steam or electric power development.
Total power required to run mill: 50 to 60 HP.
Approximate area of mill pond: 4 acres.
Approximate depth to which mill pond can be drawn: 2 feet.
This mill is entitled to 15/64 of the flow of the river.

$82.15 PER SQUARE MILE PER FOOT OF FALL = TOTAL FOR 5 MILLS ON THIS PRIVILEGE.

SEE NO. 129, "MASSACHUSETTS, WORCESTER, SUMMARY OF KETTLE BROOK CASES."

202 Rhode Island, Pawtucket, Providence County, 1895.

City of Worcester *v.* Dexter Yarn Company, Pawtucket privilege. (Kettle Brook Cases No. 44.)

DEVELOPED PRIVILEGE ON BLACKSTONE RIVER.

Authority: Charles T. Main, Boston.

BY AWARD, $525.

Watershed above privilege: 472.5161 square miles.
Water diverted: 3.856 square miles.
Fall: 7.07 feet.
Horse-power taken: Petitioner's claim, 2.70.
Defendant's claim, 0.63.
Character of development: cotton yarns.
Coal: $3.35 per 2 000 pounds.
Steam is used for manufacturing or other purposes.
No water used for other purposes than for power.
Three wheels installed: 150 HP.
Total steam and electric power development: 150 HP.
Total power required to run mill: 267 HP.
Approximate area of mill pond: 4 acres.
Approximate depth to which mill pond can be drawn: 2 feet.
This mill is entitled to 16/64 of the flow of the river.

$82.15 PER SQUARE MILE PER FOOT OF FALL = TOTAL FOR 5 MILLS ON THIS PRIVILEGE.

SEE NO. 129, "MASSACHUSETTS, WORCESTER, SUMMARY OF KETTLE BROOK CASES."

203 Rhode Island, Pawtucket, Providence County, 1895.
City of Worcester *v.* Sylvia C. Pitcher, Pitcher Mill privilege. (Kettle Brook Cases No. 44.)

DEVELOPED PRIVILEGE ON BLACKSTONE RIVER.

Authority: Charles T. Main, Boston.

BY AWARD, $525.

Watershed diverted: 3.856 square miles out of 472.5161 square miles.
Horse-power taken: Petitioner's claim, 2.22.
Defendant's claim, 0.39.
Fall: 7.07 feet.
Character of development: Power is leased to various tenants.
Coal: $3.35 per 2 000 pounds.
Steam is used for manufacturing or other purposes.
No water is used for any other purposes than for power.
One wheel installed: a little over 50 HP.
Total steam and electric power development: 50 HP.
Total power required to run mill: about 50 HP.
Approximate area of mill pond: 4 acres.
Approximate depth to which mill pond can be drawn: 2 feet.
This mill is entitled to 13/64 of the flow of the river.

$82.15 PER SQUARE MILE PER FOOT OF FALL = TOTAL FOR 5 MILLS ON THIS PRIVILEGE.

SEE No. 129, "MASSACHUSETTS, WORCESTER, SUMMARY OF KETTLE BROOK CASES."

204 Rhode Island, Pawtucket, Providence County, 1895.
City of Worcester *v.* Fred S. Farwell, Farwell Worsted Company. (Kettle Brook Cases No. 43.)

DEVELOPED PRIVILEGE ON BLACKSTONE RIVER.

Authority: Charles T. Main, Boston.

BY AWARD, $1 155.

Watershed diverted: 3.856 square miles out of 472.0678 square miles.
Horse-power taken: Petitioner's claim, 5.23.
Defendant's claim, 1.08.
Fall: 10.79 feet.
Character of development: fancy worsteds.
Coal: $3.30 per 2 000 pounds.
Steam is used for manufacturing or other purposes.
Water is used for other purposes than for power.
Three wheels installed: 169 HP.
Total steam and electric power development: 175 HP.

Total power required to run mill: 225 HP.
Approximate area of mill pond: 20 acres.
Approximate depth to which mill pond can be drawn: 2 feet.
This mill is entitled to 92½/288 of the flow of the river.

$97.00 PER SQUARE MILE PER FOOT OF FALL = TOTAL FOR 3 MILLS ON THIS PRIVILEGE.

SEE No. 129, "MASSACHUSETTS, WORCESTER, SUMMARY OF KETTLE BROOK CASES."

205 Rhode Island, Pawtucket, Providence County, 1905. (Woonsocket Cases No. 9.)

S. C. Pitcher Estate *v.* City of Woonsocket.

WELL-DEVELOPED AND SUBSTANTIAL PRIVILEGE, BLACKSTONE RIVER.

Authority: Charles T. Main, Boston.

Watershed diverted: 7.9 square miles out of 472 square miles.
Fall: 6.572 feet.
10 hour power used.
Character of development: well-developed cotton mill.
Character of watershed: typical New England.
Coal: $3.80 per 2 000 pounds.
Steam is used for heating.
One wheel installed, 50 HP.
Total steam: 50 HP.
Total power required: perhaps 40 HP.
Area of pond: 4 acres.
Working depth of pond: 2 feet.

SEE No. 214, "WOONSOCKET CASES." SEPARATE AWARDS NOT KNOWN.

206 Rhode Island, Pawtucket, Providence County, 1905. (Woonsocket Cases No. 10.)

Dexter Yarn Company *v.* City of Woonsocket.

WELL-DEVELOPED PRIVILEGE, BLACKSTONE RIVER.

Authority: Charles T. Main, Boston.

Watershed diverted: 7.9 square miles out of 472 square miles.
Fall: 6.572.
10 hour power used.
Character of development: well-developed cotton mill.
Character of watershed: typical New England.
Coal: $3.50 per 2 000 pounds.
Steam is used for heating purposes.
Three wheels installed: 150 HP.

Steam development: 220 HP.
Total power required: 267 HP.
Area of pond: 4 acres.
Working depth: 2 feet.

SEE NO. 214, "WOONSOCKET CASES." SEPARATE AWARDS NOT KNOWN.

207 Rhode Island, Pawtucket, Providence County, 1905. (Woonsocket Cases No. 11.)

Estate G. L. Spencer *v.* City of Woonsocket.

SUBSTANTIAL AND WELL-DEVELOPED PRIVILEGE, BLACKSTONE RIVER.

Authority: Charles T. Main, Boston.

Watershed diverted: 7.9 square miles out of 472 square miles.
Fall: 6.572 feet.
10 hour power used.
Character of development: well-developed cotton mill.
Character of watershed: typical New England.
Three wheels installed, presumed to be 25 HP. each.
Power required: 50 to 60 HP.
Area of pond: 4 acres.
Depth: 2 feet.

SEE NO. 214, "WOONSOCKET CASES." SEPARATE AWARDS NOT KNOWN.

208 Rhode Island, Pawtucket, Providence County, 1905. (Woonsocket Cases No. 12.)

Littlefield Manufacturing Company *v.* City of Woonsocket.

WELL-DEVELOPED PRIVILEGE, BLACKSTONE RIVER.

Authority: Charles T. Main, Boston.

Watershed diverted: 7.9 square miles out of 472 square miles.
Fall: 6.572 feet.
10 hour power used.
Character of development: well-developed cotton mill.
Character of watershed: typical New England.
Coal: $3.50 per 2 000 pounds.
Steam is used for heating purposes.
Three wheels installed, 125 HP.
Total steam power: 150 HP.
Power required: 130 HP.
Area of pond: 4 acres.
Working depth: 2 feet approximately.

SEE NO. 214, "WOONSOCKET CASES." SEPARATE AWARD NOT KNOWN.

209 Rhode Island, Pawtucket, Providence County, 1905. (Woonsocket Cases No. 13.)

Pawtucket Gas Company *v.* City of Woonsocket.

WELL-DEVELOPED AND SUBSTANTIAL PRIVILEGE, BLACKSTONE RIVER.

Authority: Charles T. Main, Boston.

Watershed diverted: 7.9 square miles out of 472 square miles.
Fall: 6.572 feet.
Character of watershed: typical New England.
One wheel installed.
Area of pond: 4 acres.
Working depth: 2 feet.

SEE NO. 214, "WOONSOCKET CASES." SEPARATE AWARD NOT KNOWN.

210 Rhode Island, Pawtucket, Providence County, 1905. (Woonsocket Cases No. 14.)

Pawtucket Electric Company *v.* City of Woonsocket.

WELL-DEVELOPED PRIVILEGE, BLACKSTONE RIVER.

Authority: Charles T. Main, Boston.

Watershed diverted: 7.9 square miles out of 472 square miles.
Fall: 16.521 feet.
24 hour power used.
Character of development: well-developed electric current.
Character of watershed: typical New England.
Coal: $3.35 per 2 000 pounds.
Eleven wheels installed, 1 300 HP.
Total steam development: 520 HP.
Power required: 1 300 HP.
Area of pond: 1 acre.

SEE NO. 214, "WOONSOCKET CASES." SEPARATE AWARD NOT KNOWN.

211 Rhode Island, Pawtucket, Providence County, 1905. (Woonsocket Cases No. 15.)

Taylor & Hallett *v.* City of Woonsocket.

SUBSTANTIAL AND WELL-DEVELOPED PRIVILEGE, BLACKSTONE RIVER.

Authority: Charles T. Main, Boston.

Watershed diverted: 7.9 square miles out of 472 square miles.
Fall: 9.93 feet.
10 hour power used.

Character of development: well-developed miscellaneous.
Character of watershed: typical New England.
Coal: $3.35 per 2 000 pounds.
One wheel installed, 40 HP.
Power required: 40 HP.
Area of pond: 4 acres.
Working depth: perhaps 2 feet.

SEE No. 214, "WOONSOCKET CASES." SEPARATE AWARD NOT KNOWN.

212 Rhode Island, Pawtucket, Providence County, 1905. (Woonsocket Cases No. 16.)

Pawtucket Electric Light Company.

WELL-DEVELOPED PRIVILEGE, BLACKSTONE RIVER.

Authority: Charles T. Main, Boston.

Watershed diverted: 7.9 square miles out of 472 square miles.
Fall: 12.66 feet.
24 hour power used.
Character of development: well developed; electric current.
Character of watershed: typical New England.
Coal: $3.35 per 2 000 pounds.
One wheel installed: 31 HP.

SEE No. 214, "WOONSOCKET CASES." SEPARATE AWARD NOT KNOWN.

213 Rhode Island, Valley Falls, Providence County, 1895.

City of Worcester *v.* Albion Company, Valley Falls privilege. (Kettle Brook Cases No. 42.)

DEVELOPED PRIVILEGE ON BLACKSTONE RIVER.

Authority: Charles T. Main, Boston.

BY AWARD, $5 040.

Watershed diverted: 3.856 out of 442.5164 square miles.
Horse-power taken: Petitioner's claim, 23.49; defendant's claim, 4.81.
Fall: 14.609 feet.
Character of development: cotton goods.
Six wheels installed, 1 033 HP.
Total steam and electric power development: 1 200 HP.
Total power required to run mill: 1 000 HP.
Approximate area of mill pond: 50 acres.
Approximate depth to which mill pond can be drawn: 2 feet.

$89.40 PER SQUARE MILE PER FOOT OF FALL.

214 Rhode Island, Woonsocket *et al.*, 1905.
Mill Owners *v.* City of Woonsocket.
WELL-DEVELOPED PRIVILEGES.
Authority: Charles T. Main, Boston.
AGREEMENT (excluding interest), $90 000, divided among the following mill owners. (For detailed statements, see preceding pages):

Name.	Watershed. (Square Miles.)		Available Fall at Mill. Feet.*	Fall on River. Feet.
	Total.	Diverted.		
1 Valley Falls Co., Albion Mill	429	7.9	12.69	12.69
2 Lonsdale, Ashton	433	7.9	9.50	
3 „ No. 1	441	7.9	23.28	23.40
4 „ No. 4	441	7.9	14.03	
5 Albion Co.	443	7.9	14.11	14.11
6 Stafford Co.	472	7.9	9.79	
7 Farwell Worsted Co.	472	7.9	9.79	9.79
8 American Hair Cloth Co.	472	7.9	9.79	
9 S. C. Pitcher Estate	472	7.9	6.57	
10 Dexter Yarn Co.	472	7.9	6.57	
11 Estate G. L. Spencer	472	7.9	6.57	6.57
12 Littlefield Mfg. Co.	472	7.9	6.57	
13 Pawtucket Gas Co.	472	7.9	6.57	
14 Pawtucket Electric Co.	472	7.9	16.52	
15 Taylor & Hallett	472	7.9	9.93	16.52
16 Pawtucket Elec. Lt. Co.	472	7.9	12.66	
Total for 16 mills = $90 000	0 for	7.9		83.08

$137.00 per Square Mile per Foot of Fall (average for 6 privileges).

215 Rhode Island, Woonsocket, Providence County, 1895.
City of Worcester *v.* George H. Baker. (Leicester Knitting Company privilege, Kettle Brook Cases Nos. 36, 37.)
DEVELOPED PRIVILEGE ON BLACKSTONE RIVER.
Authority: Charles T. Main, Boston.
BY AWARD, $210.

* This column shows the actual fall at mill, but when there are several mills upon the same fall, the water is divided; hence the next column is inserted to give the fall corresponding to the total river flow.

Watershed diverted: 3.856 square miles out of 365.2091 square miles.
Horse-power taken: (F. A. McClure, authority): Petitioner's claim, 0.72; defendant's claim, 0.20.
Fall: 7 feet.
Character of development: jackets, mittens, hosiery, etc.
Coal: $3.80 per 2 000 pounds.
Steam is used for manufacturing or other purposes.
Water is used for other purposes than for power.
One wheel installed, 135 HP.
Total steam and electric power development: 80 HP. boilers.
Total power required to run mill: 15 to 20 HP.
This mill is entitled to 6/96 of the flow of the river.

$103.95 PER SQUARE MILE PER FOOT OF FALL = TOTAL FOR 13 MILLS ON 2 PRIVILEGES.

SEE NO. 129, "MASSACHUSETTS, WORCESTER, SUMMARY OF KETTLE BROOK CASES."

216 Rhode Island, Woonsocket, Providence County, 1895.
City of Worcester *v.* American Worsted Company. (Kettle Brook Cases Nos. 36, 37.)
DEVELOPED PRIVILEGE ON BLACKSTONE RIVER.
Authority: Charles T. Main, Boston.
BY AWARD, $840.
Watershed diverted: 3.856 square miles out of 365.2091 square miles.
Horse-power taken (F. A. McClure, authority): Petitioner's claim, 3.26; defendant's claim, 0.74.
Fall: 16.667 feet.
Character of development: worsted yarns, braids, etc.
Coal: $3.80 per 2 000 pounds.
Steam is used for manufacturing or other purposes.
Water is used for other purposes than power.
Two wheels installed, 125 HP.
Total steam and electric power development: 287 HP.
Total power required to run mill: 300 to 350 HP.
This mill is entitled to 12/96 of the flow of the river.

$103.95 PER SQUARE MILE PER FOOT OF FALL = TOTAL FOR 13 MILLS ON 2 PRIVILEGES.

SEE NO. 129, "MASSACHUSETTS, WORCESTER, SUMMARY OF KETTLE BROOK CASES."

217 Rhode Island, Woonsocket, Providence County, 1895.
City of Worcester *v.* Eagle Mills. (Kettle Brook Cases Nos. 36, 37.)
DEVELOPED PRIVILEGE ON BLACKSTONE RIVER.
Authority: Charles T. Main, Boston, Mass.
BY AWARD, $1 092.
Watershed diverted: 3.856 square miles out of 365.2091 square miles.
Horse-power taken (F. A. McClure, authority): Petitioner's claim, 4.26; defendant's claim, 1.00.
Fall: 14.66 feet.
Character of development: cotton goods.
Coal: $3.80 per 2 000 pounds.
Steam is used for manufacturing or other purposes.
Water is used for other purposes than for power.
Two wheels installed, 232 HP.
Total steam and electric power development: 310 HP.
Total power required to run mill: 385 HP.
Approximate area of mill pond: 3 acres.
Approximate depth to which mill pond can be drawn: 1 foot.
This mill is entitled to 18/96 of the flow of the river.
$103.95 PER SQUARE MILE PER FOOT OF FALL = TOTAL FOR 13 MILLS ON 2 PRIVILEGES.
SEE NO. 129, "MASSACHUSETTS, WORCESTER, SUMMARY OF KETTLE BROOK CASES."

218 Rhode Island, Woonsocket, Providence County, 1895.
City of Worcester *v.* Clinton Manufacturing Company. (Kettle Brook Cases Nos. 36, 37.)
DEVELOPED PRIVILEGE ON BLACKSTONE RIVER.
Authority: Charles T. Main, Boston.
BY AWARD, $1 680.
Watershed diverted: 3.856 square miles out of 365.2091 square miles.
Horse-power taken (F. A. McClure, authority): Petitioner's claim, 7.11; defendant's claim, 1.67.
Fall: 14.66 feet.
Character of development: cotton goods, sheeting, and shirtings.
Coal: $4.90 per 2 000 pounds.
Steam is used for manufacturing or other purposes.
No water used for any other purposes than for power.
Three wheels installed, 310 HP.

Total steam and electric power development: 521 HP.
Total power required to run mill: 500 HP.
Approximate area of mill pond, 3 acres.
Approximate depth to which mill pond can be drawn: 18 inches.
This mill is entitled to 30/96 of the flow of the river.

$103.95 PER SQUARE MILE PER FOOT OF FALL = TOTAL FOR 13 MILLS ON 2 PRIVILEGES.

SEE NO. 129, "MASSACHUSETTS, WORCESTER, SUMMARY OF KETTLE BROOK CASES."

219 Rhode Island, Woonsocket, Providence County, 1895.
City of Worcester *v.* Frank Harris, Hamlet Mills. (Kettle Brook Cases No. 38.)
DEVELOPED PRIVILEGE ON BLACKSTONE RIVER.
Authority: Charles T. Main, Boston.
BY AWARD, $3 150.
Watershed diverted: 3.856 square miles out of 367.4001 square miles.
Horse-power taken (F. A. McClure, authority): Petitioner's claim, 14.70; defendant's claim, 2.88.
Fall: 9.33 feet.
Character of development: shirtings and sheetings.
Coal: $3.70 per 2 000 pounds.
Steam is used for manufacturing or other purposes.
Water is used for other purposes than for power.
Three wheels installed, 455 HP.
Total steam and electric power development: 125 HP.
Total power required to run mill: about 450 HP.
Approximate area of mill pond: 40 acres.
Approximate depth to which mill pond can be drawn: 2 feet.

$87.70 PER SQUARE MILE PER FOOT OF FALL.

SEE NO. 129, "MASSACHUSETTS, WORCESTER, SUMMARY OF KETTLE BROOK CASES."

220 Rhode Island, Woonsocket, Providence County, 1895.
Edgar K. Ray *et al.* (Ray Cotton privilege) *v.* City of Worcester. (Kettle Brook Cases Nos. 36, 37.)
DEVELOPED PRIVILEGE.
Authority: Charles T. Main, Boston, Mass.
BY AWARD, $420 (exclusive of interest).
Watershed above privilege: 365.2091 square miles.

Horse-power taken (F. A. McClure, authority):
Petitioners' claim, 1.63.
Defendant's claim, 0.37.
Water diverted: 3.856 square miles.
Fall: 16.66 feet.
Character of development: cotton cloth.
Coal: $3.80 per 2 000 pounds.
Steam is used for other purposes.
Two wheels installed, 200 HP.
Total steam and electric power development: 180 HP.
Power required: 200 HP.
Working depth of pond: 18 inches.
This mill is entitled to 6/96 of the flow of the stream.

$103.95 PER SQUARE MILE PER FOOT OF FALL = TOTAL FOR 13 MILLS ON 2 PRIVILEGES.

SEE NO. 129, "MASSACHUSETTS, WORCESTER, SUMMARY OF KETTLE BROOK CASES."

221 Rhode Island, Woonsocket, Providence County, 1895.

Woonsocket Electric Machine and Power Company, (*a*) Main Street Station, No. 1 power station privilege, *v.* City of Worcester. (Kettle Brook Cases Nos. 36, 37.)

DEVELOPED PRIVILEGE.

Authority: Charles T. Main, Boston.

BY AWARD, $3 717 (exclusive of interest).

Watershed diverted: 3.856 square miles out of 365.2091 square miles.
Horse-power taken (F. A. McClure, authority):
Petitioner's claim, 13.63.
Defendant's claim, 3.20.
Fall: 16.66 feet.
Character of development: power and lighting.
Coal: $3.80 per 2 000 pounds.
Steam is used for other purposes.
Four wheels installed: 600 HP.
Total power: 125 HP.
This mill is entitled to 18/96 of the flow of the river.

$103.95 PER SQUARE MILE PER FOOT OF FALL = TOTAL FOR 13 MILLS ON 2 PRIVILEGES.

SEE NO. 129, "MASSACHUSETTS, WORCESTER, SUMMARY OF KETTLE BROOK CASES."

222 Rhode Island, Woonsocket, Providence County, 1895.
Woonsocket Electric Machine and Power Company, (*b*) Front Street, No. 2 power station privilege, *v.* City of Worcester. (Kettle Brook Cases Nos. 36, 37.)
DEVELOPED PRIVILEGE.
Authority: Charles T. Main, Boston.
BY AWARD (included in the preceding).
Watershed diverted: 3.856 square miles out of 365.2091 square miles.
Fall: 13 feet.
Character of development: electric light and power.
Coal: $3.80 per 2 000 pounds.
Steam is used for other purposes.
Four wheels installed, 410 HP.
Total steam and electric power development: 650 HP.
Area of pond: 14.64 acres.
This mill is entitled to 42/96 of the flow of the river.
$103.95 PER SQUARE MILE PER FOOT OF FALL = TOTAL FOR 13 MILLS ON 2 PRIVILEGES.
SEE NO. 129, "MASSACHUSETTS, WORCESTER, SUMMARY OF KETTLE BROOK CASES."

223 Rhode Island, Woonsocket, Providence County, 1895.
Social Manufacturing Company (Globe Mill privilege) *v.* City of Worcester. (Kettle Brook Cases Nos. 36, 37.)
DEVELOPED PRIVILEGE.
Authority: Charles T. Main, Boston.
BY AWARD, $945 (exclusive of interest).
Watershed diverted: 3.856 square miles, out of 365.2091 square miles.
Horse-power taken (F. A. McClure, authority):
Petitioner's claim, 3.90.
Defendant's claim, 1.67.
Fall: 18.333 feet.
Character of development: sheetings.
Coal: $4.80 per 2 000 pounds.
Steam is used for other purposes.
Three wheels installed, 260 HP.
Total power development: 1 100 HP.
Power required: 1 050 to 1 150 HP.
Area of pond: 47.46 acres.
This mill is entitled to 6/96 of the flow of the river.
$103.95 PER SQUARE MILE PER FOOT OF FALL = TOTAL FOR 13 MILLS ON 2 PRIVILEGES.

SEE NO. 129, "MASSACHUSETTS, WORCESTER, SUMMARY OF KETTLE BROOK CASES."

224 Rhode Island, Woonsocket, Providence County, 1895.
Joseph G. Ray *et al.* (Lyman Mill privilege) *v.* City of Worcester. (Kettle Brook Cases Nos. 36, 37.)
DEVELOPED PRIVILEGE.
Authority: Charles T. Main, Boston, Mass.
BY AWARD, $446 (exclusive of interest).
Watershed diverted: 3.856 out of 365.2091 square miles.
Horse-power taken (F. A. McClure, authority):
Petitioners' claim, 1.83.
Defendant's claim, 0.47.
Fall: 18.333 feet.
Character of development: cotton cloth mill.
Coal: $4.00 per 2 000 pounds.
One wheel installed, 100 HP.
Power required to run mill: 35 HP.
Working depth of pond: 1½ feet.
This mill is entitled to 6/96 of the flow of the river.
$103.95 PER SQUARE MILE PER FOOT OF FALL = TOTAL FOR 13 MILLS ON 2 PRIVILEGES.
SEE NO. 129, "MASSACHUSETTS, WORCESTER, SUMMARY OF KETTLE BROOK CASES."

225 Rhode Island, Woonsocket, Providence County, 1895.
Edgar K. Ray *et al.* (*a*) Bartlett privilege, (*b*) Ballou privilege, *v.* City of Worcester. (Kettle Brook Cases Nos. 36, 37.)
DEVELOPED PRIVILEGE.
Authority: Charles T. Main, Boston.
BY AWARD $1 648 (exclusive of interest).
Watershed diverted: 3.856 square miles out of 365.2091 square miles.
Horse-power taken: (F. A. McClure, authority):
Petitioners' claim, Bartlett, 1.56; Ballou, ?
Defendant's claim, Bartlett, 1.32; Ballou, ?
Fall: 18.333 feet.
Character of development:
Ballou, cotton spinning.
Bartlett, cotton weaving and spinning.
Coal: about $4 per 2 000 pounds.
Steam is used for other purposes.

Wheels installed: Ballou, two 300 HP.
Bartlett, one 70 HP.
Total power development: Ballou, 275 HP.
Bartlett, 50 HP.
Power required: Ballou, 300 HP. (about).
Bartlett, 75 HP.
Ballou mill is entitled to 17/96 of flow of river.
Bartlett mill is entitled to 6/96 of flow of river.

$103.95 PER SQUARE MILE PER FOOT OF FALL = TOTAL FOR 13 MILLS ON 2 PRIVILEGES.

SEE NO. 129, "MASSACHUSETTS, WORCESTER, SUMMARY OF KETTLE BROOK CASES."

226 Rhode Island, Woonsocket, Providence County, 1895.
Margaret F. O'Reilly *et al.* (grist mill privilege) *v.* City of Worcester. (Kettle Brook Cases Nos. 36, 37.)

DEVELOPED WATER PRIVILEGE.

BY AWARD, $268.50 (exclusive of interest).

Watershed diverted: 3.856 square miles out of 365.2091 square miles.
Horse-power taken (F. A. McClure, authority): Petitioners' claim, 1.85; defendant's claim, 0.53.
Fall: 18.333 feet.
Character of development: meal mill.
Three wheels: 122 HP.
This mill is entitled to 3/96 of the flow of the river.

$103.95 PER SQUARE MILE PER FOOT OF FALL = TOTAL FOR 13 MILLS ON 2 PRIVILEGES.

SEE NO. 129, "MASSACHUSETTS, WORCESTER, SUMMARY OF KETTLE BROOK CASES."

227 Rhode Island, Woonsocket, Providence County, 1895.
Margaret F. O'Reilly *et al.* (Harris Woolen Company privilege) *v.* City of Worcester. (Kettle Brook Cases Nos. 36, 37.)

DEVELOPED PRIVILEGE.

Authority: Charles T. Main, Boston, Mass.

BY AWARD, $268.50 (exclusive of interest).

Watershed diverted: 3.856 square miles out of 365.2091 square miles.
Fall: 18.333 feet.
This mill is entitled to 3/96 of the flow of the river.

$103.95 PER SQUARE MILE PER FOOT OF FALL = TOTAL FOR 13 MILLS ON 2 PRIVILEGES.

SEE NO. 129, "MASSACHUSETTS, WORCESTER, SUMMARY OF KETTLE BROOK CASES."

228 Rhode Island, Woonsocket, Providence County, 1895.
Lippitt Woolen Company *v.* City of Worcester. (Kettle Brook Cases Nos. 36, 37.)
DEVELOPED WATER PRIVILEGE.
Authority: Charles T. Main, Boston, Mass.
BY AWARD, $1 050 (exclusive of interest).
Watershed diverted: 3.856 square miles out of 365.2091 square miles.
Fall: 16.66 feet.
7.33 „
Character of development: woolens.
Coal: $3.80 per 2 000 pounds.
Steam is used for other purposes.
Water is used for other purposes.
Two 100-HP. wheels installed.
Total electric and steam power development: 200 HP.
Power required: 220 HP.
Working depth of pond: 1 foot to 18 inches.
This mill is entitled to 12/96 of the flow of the river on the 16.66 foot fall, and 6/96 on the 7.33 foot fall.
$103.95 PER SQUARE MILE PER FOOT OF FALL = TOTAL FOR 13 MILLS ON 2 PRIVILEGES.
SEE NO. 129, "MASSACHUSETTS, WORCESTER, SUMMARY OF KETTLE BROOK CASES."

229 Vermont, Barre, Washington County, 1897.
Barre Water Company *v.* MacFarland & Boyce.
SMALL DEVELOPED PRIVILEGE.
Authority: C. T. Main, Boston, Mass.
AWARD, $300 (exclusive of interest).
Character of privilege: variable, small flow in dry months.
Watershed above privilege: 42 square miles.
Watershed taken: 2.7 square miles.
Fall taken and developed: 8 feet.
9 hour working day.
Character of development: stone cutters.
Watershed: hilly.
Coal per 2 000 pounds: $4.02.
One 15 HP. wheel installed.
Power required to run mill: 15 HP.
Area of mill pond: very small.
Storage reservoirs: Peck pond, 20 acres, 12 feet deep = 20 454 400 cubic feet.
$13.90 PER SQUARE MILE PER FOOT OF FALL.

230 Vermont, Barre, Washington County, 1897.
Barre Water Company *v.* The Woolen Mill.
DEVELOPED PRIVILEGE. UNUSED.
Authority: C. T. Main, Boston, Mass.
AWARD, $900 (exclusive of interest).
Character of privilege: variable, small flow in dry months.
Area of watershed: 42 square miles.
Watershed taken: 2.7 square miles.
Fall: 28 feet 4 inches.
Fall used: 28 feet 4 inches.
No wheel, steam power, or business; abandoned about 5 years.
Character of watershed: hilly.
Coal per 2 000 pounds: $4.02.
Area of mill pond: small.
Storage reservoirs: Peck pond, 20 acres, 12 feet deep = 20 454 400 cubic feet.
$11.80 PER SQUARE MILE PER FOOT OF FALL.

231 Vermont, Barre, Washington County, 1897.
Barre Water Company *v.* McDonald & Buchan.
SMALL DEVELOPED PRIVILEGE.
Authority: C. T. Main, Boston, Mass.
AWARD, $1 350 (exclusive of interest).
Character of privilege: variable, small flow in dry months.
Watershed above privilege: 42 square miles.
Watershed taken: 2.7 square miles.
Fall taken and developed: 12 feet 3 inches.
9-hour power used.
Character of development: stone cutters.
Character of watershed: hilly.
Coal: 2 000 pounds, $4.02.
One 30-inch Hercules wheel 57 HP. installed.
Boiler: 25 to 30 HP. engine.
Power required: 57 HP.
Supplementary steam necessary: about 23 HP. average for seven months.
Area of mill pond: small.
Storage reservoirs: Peck pond, 20 acres, 12 feet deep = 20 454 400 cubic feet.
Controlling factor in award: simply to make good the value of power diverted.
$40.80 PER SQUARE MILE PER FOOT OF FALL.

232 Vermont, Barre, Washington County, 1897.
Barre Water Company *v.* Marr & Gordon.
DEVELOPED WATER PRIVILEGE.
Authority: Charles T. Main, Boston, Mass.
BY AWARD, $1 100 (exclusive of interest).
Character of privilege: variable, small flow in dry months.
Area of watershed: 42 square miles.
Watershed taken: 2.7 square miles.
Fall taken and developed: 14 feet 8 inches.
9 hour power used.
Character of development: stone dam.
Character of watershed: hilly.
Cost of coal per 2 000 pounds: $4.02.
Steam is used for other purposes.
One 30-inch Hercules wheel installed, 78 HP.
Total steam development: 100 HP. boiler, 45-40 HP. engine.
Power required to run mill: 40 HP.
Supplementary steam necessary: about 24 HP. average for six months.
Area of mill pond: 50 feet by ½ mile.
Storage reservoirs upon watershed: Peck's pond, 20 acres, 12 feet deep = 20 454 400 cubic feet.
Controlling factor in award: to make good power diverted.
$27.70 PER SQUARE MILE PER FOOT OF FALL.

233 Vermont, Barre, Washington County, 1897.
Barre Water Company *v.* J. S. Robinson.
SMALL DEVELOPED PRIVILEGE.
Authority: C. T. Main, Boston, Mass.
AWARD, $1 100 (exclusive of interest).
Character of privilege: variable small flow in dry months.
Area of watershed: 42 square miles.
Watershed diverted: 2.7 square miles.
Fall: 22 feet 7 inches.
Fall used: 22.58 feet.
9 hour working day.
Character of development: wooden dam, in very poor repair.
Watershed: hilly.
Coal: $4.02 per 2 000 pounds.
One wheel 120 HP. installed.
Power required to run mill: 60 HP.
Area of mill pond: 100 feet wide.
Storage reservoirs upon watershed:
20 acres, 12 feet deep = 20 454 400 cubic feet.
$18.00 PER SQUARE MILE PER FOOT OF FALL.

APPENDIX C.

DECEMBER 7, 1908.

NEW ENGLAND WATER WORKS ASSOCIATION.

DATA FOR COMMITTEE UPON WATER AND WATER-POWER DIVERSION.

Kindly fill in and return this data sheet to LEONARD METCALF,
Secretary Water and Water-Power Diversion Committee,
14 Beacon Street, Boston, Mass.

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1. Date of valuation, sale, or award.
2. Amount thereof, exclusive of interest ($).
3. Total amount, including interest and allowances for collateral items.
4. Corporate names of both parties.
5. Location, town, city, county, and state.
6. Character of privilege.
7. Total area of watershed above privilege.
8. Amount of watershed taken or diverted.
9. Amount of water taken or diverted.
10. Theoretical fall taken to which right was claimed.
11. Fall used or developed.
12. Hours per day during which power is used.
13. Character of development, product of mill, etc.
14. Character of watershed.
15. Cost of coal per 2 000 pounds, and of electric current per kilowatt hour.
16. Is steam used for manufacturing or other purposes?
17. Is water used for any other purposes than for power?
18. Number of wheels installed.
19. Power of wheels.
20. Total steam and electric power development.
21. Total power required to run mill.
22. If supplementary steam or electricity is necessary, state amount.
23. What must be done to improve the privilege, or to develop undeveloped available power there, and what is the estimated cost thereof?
24. Approximate area of mill pond.
25. Approximate depth to which mill pond can be drawn.
26. Are there storage reservoirs upon the watershed? If so, state capacity.
27. Character of control of the storage.
28. What were the controlling factors in the award?
29. Did the award include any allowances other than for the water or water power?

Remarks:

(Signed)

APPENDIX D.

BIBLIOGRAPHY.

PAPERS IN THE JOURNAL OF THE NEW ENGLAND WATER WORKS ASSOCIATION.

A Method of Estimating the Loss of Water Power in a Stream by Taking Water therefrom for a City Supply. By L. M. Hastings. (Vol. 7, p. 187, June, 1893.)

The Water Power at Holyoke. By Albert F. Sickman. (Vol. 18, p. 337, 1904.)

Computation of the Values of Water Powers and the Damages Caused by the Diversion of Water used for Power. By Charles T. Main. (Vol. 21, p. 214, September, 1907.)

Damages Caused by the Diversion of Water. By Clemens Herschel. (Vol. 21, p. 241, September, 1907.)

Water Rights. By Richard A. Hale. (Vol. 21, p. 248, September, 1907.)

Flow of Streams from a Water Power Standpoint. By Charles E. Chandler. (Vol. 21, p. 434, December, 1907.)

Stream Flow Data. By Charles E. Chandler. (Vol. 22, p. 409, December, 1908.)

Compensation in Kind for Diversion of Water. By Robert E. Horton. (Vol. 22, p. 334, September, 1908.)

Power of a Running Stream without Storage. By William G. Raymond. (Vol. 22, p. 184, June, 1908.)

The Newton, N. J., Water Works, etc. By L. L. Tribus. (Vol. 23, June, 1909.)

PAPERS IN TRANSACTIONS OF AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Comparative Cost of Steam and Water Power. By Charles H. Manning. (No. 332, Vol. X, p. 499.

Cost of Steam and Water Power. By Charles T. Main. (No. 360, Vol. XI, p. 108.)

Value of a Water Power. By Charles T. Main. (No. 471, Vol. XIII, p. 140, 1892.)

Cost of an Indicated Horse Power. By DeCourcy May. (No. 603, Vol. XV, p. 1146.)

On the Value of a Horse Power. By George I. Rockwood. (No. 848, Vol. XXI, p. 590.)

An Analysis of the Commercial Value of Water Power per Horse Power per Annum. By A. F. Nagle. (No. 967, Vol. XXIV, p. 286.)

Computations of the Values of Water Powers and the Damages Caused by the Diversion of Water Used for Power. By Charles T. Main. (No. 1057, Vol. XXVI.)

LIBRARY OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

SEARCH FOR MATERIAL ON AWARDS FOR WATER OR WATER-POWER DIVERSION, MARCH 11, 1909.

NOTE. — Theoretical articles are omitted. This is not a complete search.

These references result from an examination of the following: Transactions American Society of Civil Engineers; Catalogue of the library, under "Water Supply Works" from Adams, Mass., to Fall River, Mass.; Engineering Index, 1881 to 1907, inclusive; Journal of the Franklin Institute, 1826 to 1885, inclusive; "Bibliography of Municipal Problems and City Conditions," by Robert C. Brooks; Engineering News, 1872 to 1904, inclusive.

Calculations of the Mean Horse-Power of a Variable Stream and the Cost of Replacing the Power Lost by a Partial Diversion of the Flow. By William H. Grant, member American Society of Civil Engineers. Transactions American Society of Civil Engineers, Vol. 22, p. 402 (Paper 440, June, 1890). (A brief reference in the discussion by Charles E. Emery, member American Society of Civil Engineers, to damages awarded by the city of Fall River, Mass., for the use of part of the water from Watuppa Ponds.)

Water Power at Niagara Falls. By Samuel McElroy. Journal Association of Engineering Societies, Vol. 4, p. 395, September, 1885. (Award for land, including hydraulic power taken by New York legislature to locate a public park. State award, $81 690 for the entire claim, of which it is said the allowance for water power was based on 105 HP. at $10.)

A Retrospect of an Arbitration on the Value of a Water Works. By Albert H. Wehr. Proceedings American Water Works Association, Vol. 26, p. 361, 1906. John M. Diven, Secretary, Charleston, S. C. (In an arbitrated case of the mayor and city council of Baltimore against the Baltimore County Water and Electric Company, the award was fixed at $230 618. This amount equaled a capitalization, at 4 per cent., of the loss of the present net income.)

Compensating Reservoirs for Gravity Water Supplies in Lieu of Compensation for Riparian Rights and Its Legal Aspects. By S. E. Babcock. Proceedings American Water Works Association, Vol. 18, p. 101, 1898. John M. Diven, Secretary, Charleston, S. C. (The city of Little Falls pays $5 000 for right to the diversion of water.)

Abstract of same. *Compensation Water for Mills.* Engineering Record, Vol. 38, p. 76, June 25, 1898.

A Method of Estimating the Loss of Water Power in a Stream by Taking the Water therefrom for a City Supply. By L. M. Hastings. JOURNAL NEW ENGLAND WATER WORKS ASSOCIATION, Vol. 7, p. 187, June, 1893. (The owners of four water powers on Charles River, below its junction with Stony Brook, brought suit against the city of Cambridge for compensation for diversion of water. Instead of a damage of $160 000 as claimed, the commissioners awarded the lump sum of $15 000.)

Abstract of same. *Estimation of the Loss of Water Power in a Stream by Taking Water for a City Supply.* Engineering Record, Vol. 27, p. 296, March 11, 1893.

An Important Decision upon a Mill Owner's Suit to Collect Damages for Diversion of Water (letter). By Louis L. Tribus. Engineering News, Vol. 43, p. 228, April 5, 1900. (The Sparks Manufacturing Company and W. H. Ingersoll brought suit for diversion of water against the town of Newton, N. J.; the awards in the lower court were $3 302 and $2 650, being on the old principle of equivalent cost of steam power capitalized. The Court of Appeals and Errors reversed the award, making it on the basis of difference in market value before and after diversion; therefore states that $750 and $500 respectively to Sparks and Ingersoll is ample remuneration.)

The Ownership of Underground Water in New York (editorial). Engineering Record, Vol. 39, p. 447, April 15, 1899. (In a suit of Forbell *v.* City of New York, $6 000 damages were awarded for the diversion of underground water.)

The Estimation of Damages to Power Plants from Back Water. Engineering Record, Vol. 45, p. 392, April 26, 1902. (A decision of the Maine Supreme Court in National Fiber Board Company *v.* Lewiston & Auburn Electric Light Company; plaintiff was awarded $800.)

A New Ruling Concerning Underground Water Rights. Engineering Record, Vol. 44, p. 49, July 20, 1901. (Award of damages to market gardeners for pumping underground water by New York City.)

Proposed Compensation in Kind for Water Diverted for the Supply of Norwich, Conn. By Hill, Quick, and Allen. Engineering News, Vol. 45, p. 381, May 23, 1901.

The Latest Decision Affecting Underground Water Supplies, Borough of Brooklyn, New York City. Engineering News, Vol. 44, p. 385, December 6, 1900. (Forbell *v.* City of New York. Award, $6 000.)

Water Power, Its Measurement and Value, with Data Respecting Damages Awarded. By George A. Kimball. Journal Association of Engineering Societies, Vol. 13, p. 71, February, 1894. Damages awarded to Willard Sibley and others caused by the taking of land, water power, and mills in the city of Waltham and town of Weston, Mass. The award of the commission, including all damages for taking land, buildings, water power, and machinery, was $34 023 and interest. The city paid in settlement $35 543, with interests and costs. The water power was estimated at $10 000 by the commissioners. Pages 84 and 104 give a number of other awards for water diversion.)

The Schuylkill Navigation Company's Canal and Water Rights. Engineering News, Vol. 24, p. 492. November 29, 1890 (Awards by the city of Philadelphia to several counties for the water rights in the canal as a means for increasing the water supply of Philadelphia.)

Discussion on Diversion of Water Power. JOURNAL NEW ENGLAND WATER WORKS ASSOCIATION, Vol. 21, p. 272, September, 1907. (Contains a table showing awards made in

1903 for damage to water powers below dam of Tomhannock Reservoir, Troy, N. Y., water works.)

On the Value of a Horse-Power. By George I. Rockwood. Transactions American Society of Mechanical Engineers, Vol. 21, p. 590, 1900. (The award for the diversion of Kettle Brook by the city of Worcester was $615 259.)

The Value of a Water Power. By Charles T. Main. Transactions American Society Mechanical Engineers, Vol. 13, p. 155, 1891–92. (Brief reference in discussion to damages awarded by the city of Fall River, Mass.)

Holyoke Water Power Company v. *City of Holyoke.* Vol. 20, p. 119. Boston, 1903. George H. Ellis, 272 Congress Street. (Awards for diversion of water.) (Ia-28.)

In Supreme Court, General Term, Fifth Department. In the Matter of the Application of the City of Rochester to Acquire the Permanent and Perpetual Right to Draw from Hemlock and Canadice Lakes an Amount of Water Sufficient for the Use of Said City and Its Inhabitants not Exceeding Nine Millions of Gallons per Day. Record on Appeal from Order Confirming Report of Commissioners, Vol. 1, p. 79, 1884. (Original awards for water diversion.) (Dc-472.)

Annual Report of the Syracuse Water Board of the City of Syracuse, N. Y., Year Ending July 31, 1894, p. 21. Syracuse, 1894. John T. Delany, Superintendent Bureau of Water. (The awards in condemnation cases to acquire eighteen different water-power rights upon the outlet of Skaneateles Lake.)

First Annual Report of the Metropolitan Water and Sewerage Board, January 1, 1902, p. 20. Boston, 1902. Henry H. Sprague, chairman, 1 Ashburton Place. (Award to the city of Boston for entire damages for taking, on January 1, 1898, of the sources of water supply and other property of that city, fixed at $12 531 000.) (Dc-1112.)

Sixth Annual Report of the Metropolitan Water Board, January 1, 1901, p. 34. Boston, 1901. (Settlement effected with the city of Nashua for the taking and diversion of the waters of the south branch of the Nashua River. Award, $33 000.) (Dc-505.)

LIBRARY OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

SEARCH FOR MATERIAL ON AWARDS FOR WATER OR WATER-POWER DIVERSION, MARCH 24, 1909.

NOTE. — Continuation of search on the same subject made March 11, 1909.

These references result from an examination of the following: Catalogue of the library under "Water Power"; also under "Water Supply Works" from Fall River, Mass., to Lyons, France, inclusive.

Report of the Water Commissioners, Fitchburg, Mass., 1892, pp. 15, 22. Fitchburg, Mass, 1893. Thomas C Lovell, clerk Board of Water Commissioners. (Awards were made to Franklin Wyman, land, water rights, buildings, and machinery, $75 000; and to parks, land, and water rights, $1 800.) (Dc-55.)

Second Annual Report of the Water Commissioners of the City of Fitchburg, pp. 15–19. Fitchburg, Mass., 1874. (Award for land damages and water right, $2 400 made at Warren W. Shattuck for the diversion of Shattuck Brook.)

Third Report of the Water Commissioners of the Town of Fitchburg, ending January 6, 1873, pp. 6–8. (Settled with James P. Putnam for $2 000 and with William Baker for $1 500 for diverting water from their mill privileges.)

Third Annual Report of the Board of Water Commissioners of the Village of Gloversville, N. Y., for the Year Ending April 30, 1880, p. 24. Gloversville, N. Y. Alexander Orr, clerk, Board of Water Commissioners. (Award for damages to A. J. Kasson, Morris mill, $3 250. Arbitration, $45.) (Dc-57.)

Sixth Annual Report of the Water Commissioners of Gloversville, N. Y., February 1, 1896, pp. 15–27. (Claims allowed for damages by water commissioners.)

Seventh Annual Report of the Water Commissioners of Gloversville, N. Y., February 1, 1897, p. 7. (Award to Edward Elphee for diversion of the Potter and Rice Creeks was $506.41.)

Ninth Annual Report of the Board of Water Commissioners of the City of Gloversville, N. Y., February 1, 1899, p. 9. (Judgments paid with costs during the year.)

City of Bangor, 1878–89, Annual Report of the Water Board, pp. 10–13. Bangor, Me., 1879. (The whole amount paid for flowage thus far, including $846.15 paid last year, is $3 282.75 damages, and $341.57 costs.) (Dc-422.)

The Water Question, a Plain Statement of the Case in All Its Bearings, with the Accompanying Documents and Map, April, 1877, pp 34–57. By Edward Saportas, New York, 1877. Amerman & Co., 47 Cedar Street. (Paid to the Mahopac Manufacturing Company for balance due for water drawn from Lake Mahopac and Lake Kirk during summer and fall of 1870, $10 500; also refers in the preface to an award for damages of 6½ cents for tapping Lake Mahopac.) (Dc-1367.)

Report of the Selectmen on the Financial Affairs of the Town of Hingham for the Year Ending February 1, 1876, p. 142. Hingham, 1876. ($3 000 was paid for mill property and privilege at Accord Pond.) (Oh-35-2.1.)

Reports on a Municipal Water Supply for the City of Gloucester, Mass., April 7, 1894, and March 5, 1895, p. 10. Gloucester, Mass., 1895. (An old mill privilege, for which $2 000 was paid; and Dike's meadow flowage area, for which something less then $2 000 was paid, etc., were brought from various owners.) (Dc-1339.)

Report of the Board of Water Commissioners, Franklin, N. H., 1892, pp. 18–47; 1893, p. 12. Franklin Falls, N. H., 1892–93. (Refers to purchase of water power from the Winnepissiogee Paper Company and W. F. Daniell.) (Dc-1131.)

LIBRARY OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

SEARCH FOR MATERIAL ON AWARDS FOR WATER-POWER DIVERSION, APRIL 20, 1909.

NOTE. — This is a continuation of searches on the same subject made March 11 and 24, 1909.

These references result from an examination of the following: Catalogue of the library under "Water Supply Works," from Paris, France, to Zurich, Switzerland. Engineering Index, 1908.

The Twenty-Ninth Annual Report of the Board of Water Commissioners of the City of Hartford for the Year Ending March 1, 1883, p. 10. Hartford, Conn., 1883. Fred T. Berry, Secretary. (The law suit brought by Martin Luther, of Newington, against the Board of Water Commissioners, for diverting water from his mill privilege by the construction of Farmington reservoir, has ended in a verdict in his favor for $2 750, which, with cost of proceedings, brings the loss to over $3 500.) (Dc-59.)

Annual Report of the Board of Water Commissioners of the City of Holyoke, December 28, 1874, p. 9. Holyoke, Mass., 1875. Thomas J. Carmody, Secretary. (In the suit of J. S. Hurlbutt and others to recover damages for the taking of the waters of Ashley's and Wright's ponds, the jury returned a verdict in the alternative, assessing the damages at $2 000 if the claimants are entitled only to the natural flow of the brook running from the lower pond, and at $4 000 if they also have a right to raise the waters in the ponds by a dam, and use them as reservoirs, the claimants' rights to be determined by the Supreme Court hereafter.) (Dc-61.)

Annual Report of the Board of Water Commissioners of the City of Holyoke, December 31, 1875, p. 13. Holyoke, Mass., 1896. (A settlement of the Hurlbutt suit was made by the payment of the verdict and costs without interest. It was thought that the Supreme Court would overrule the claim on which the lesser verdict was based, and that if a new trial was had, the damages awarded were as likely to be more as less, and that it was advisable, under the circumstances, to stop costs and interest by a settlement. The amount of $4 317.71 was, therefore, paid to the plaintiff's attorneys, and a full discharge of this vexatious claim obtained.) (Dc-61.)

Annual Report of the Water Board of the City of Holyoke, 1882, p. 7. Holyoke, Mass, 1883. (In order to make fully available and also to keep from pollution the waters of Tannery Brook, we have purchased of Austin Goodyear the tract of land known as the "Bagg" farm, together with the buildings situated thereon; also the right and privilege to forever divert the waters of Tannery Brook, paying therefor the sum of $3 300, which is full payment for any damage that said Goodyear may sustain by reason of said diversion.) (Dc-61.)

Thirty-First Annual Report of the Water Board of Holyoke, Mass., for the Year 1902, p. 7. Holyoke, Mass., 1903. (The Shoals damage case, one of the cases in connection with the taking of the southwest branch of the Manhan River, was settled for $676.94.)

Third Annual Report of the Leominster Water Board, Year Ending March 1, 1875, p. 10. Leominster, Mass. W. J. Wetherbee, Superintendent. (Awards for damages caused by the diversion of Morse Brook, the "Woolen Mill," or "Crocker" privilege, $1 666.67: the privilege belonging to the Messrs. Lockey Brothers, $1 100. Twelve other cases have been settled in which the parties have been paid $16 075, names of the parties not mentioned. In treasurer's report payments to six different firms or persons for water rights and land are noted.) (Dc-74.)

Reports of the Water Commissioners and Water Registrar of Malden, Mass., for 1875, p. 3. Boston, Mass, 1876. George W. Barrett, Water Registrar. (A verdict has been rendered in favor of James P. Thorndike, for damages to the Hurd and Grundy Mills for $1 000, with costs and interest, amounting to $1 825. The claim of the Haywardville Rubber Company has been settled by the payment of the $10 000 and costs and interest amounting to $14 679.92.) (Dc-81.)

Fourth Annual Report of the Water Commissioners of the Town of Medford, 1874, p. 3. Medford, Mass. Frederick W. Gow, Superintendent. (The suits for water damages of Henry Barrett *et al.* and of George W. Phillips, administrator of estate of David Dyer, have been tried before the sheriff's jury, and in a former case a verdict of $11 500 with interest was returned, and in the latter case $50 397.78, interest included.) (Dc-87.)

Annual Report of the Water Commissioners of the Town of Medford, 1875, p. 5. Medford, Mass., 1875. (Further data on the above awards.) (Dc-81.)

Report of the Water Commissioners of the Town of Medford for the Year 1875, p. 5. Medford, Mass., 1876. (Awards to the Haywardville Rubber Company and John P. Thorndike for damages arising from taking the water.) (Dc-87.)

Report of the Water Commissioners of the Town of Melrose for the Year Ending January 1, 1874, p. 53. Melrose, Mass. (Claims for damages for diversion of water made conjointly against the three towns, Melrose, Medford, and Malden.) (Dc-88.)

Report of the Board of Water Commissioners of the Town of Melrose for Year Ending January 1, 1875, Boston, 1875. (Awards for the above claims for damages.) (Dc-88.)

Report of the Board of Water Commissioners of the Town of Melrose for the Year Ending March 1, 1876, p. 3. Boston, 1876. (Dc-88.)

City of Meriden, Annual Report of the Water Department, Year Ending November 30, 1884, p. 6. Meriden, Conn. (Award for diversion of water to the Peck, Stow & Wilcox Co., of Southington and Berlin, $5 500.) (Dc-90.)

City of Meriden, Annual Report of the Water Department, Year Ending November 30, 1885, p. 5. (Award to the Moore Manufacturing Company, $500, and the Dudley Mills, $225, for diversion of water.) (Dc-90.)

Annual Report of the Board of Water Commissioners of the City of New Britain, Conn., for the Year Ending March 31, 1900, pp. 4–13. New Britain, Conn. P. J. Egan, clerk. (Awards for mill damages by the diversion of water.) (Dc-97.)

Forty-Eighth Annual Report of the Board of Water Commissioners of the City of New Britain, Conn., for the Year Ending March 31, 1905, p. 14. New Britain, Conn., 1905. (Award to D. E. Mills for land, buildings, and water rights, $4 600.) (Dc-97.)

City of Newton, Mass., Annual Report of the Water Commissioner for the Year Ending December 31, 1903, p. 3. Newton, Mass. J. C. Whitney, water commissioner. (A payment of $15 000 was made to the owners of mill privileges on the Charles River for the right to take 3 500 000 gallons daily in addition to the 1 500 000 for which the city made a settlement in 1879.) (Dc-305a.)

Report of the Superintendent of the City of Norwich Water Works to the Board of Water Commissioners from April 1, 1877, to March 31, 1878, p. 3. Norwich, Conn. (States that all of unsettled claims against the Board of Water Commissioners for damages for turning the water of "Byron Brook" have been settled, including suits in court of E. R. Cory, $1 500 award, and C. C. Bliss, $400.) (Dc-114.)

Twenty-Second Annual Report of the Executive Board of the City of Rochester, N. Y., for the Year Ending December 31, 1897, p. 59. Rochester, N. Y. Edwin A. Fisher, city engi-

neer. (The heirs of Cora J. Trimmer were awarded $1 000 as a settlement for claims for damages of mill privilege on Honeoye Lake by the diversion of water from Canadice and Hemlock lakes.) (Or 15-2.1.)

Nineteenth and Twentieth Annual Reports of the Executive Board of the City of Rochester for the Years from April 1, 1894, to January 1, 1896, p. 65. (Awards for diversion of water from Honeoye Creek and from Hemlock and Canadice lakes.) (Or 15-2.1.)

Seventeenth Annual Report of the Executive Board, Rochester, N .Y., 1893, p. 18. (Damages paid to owners for damages to mill privilege.) (Or 15-2.1.)

Sixteenth Annual Report of the Executive Board, Rochester, N. Y., 1892, p. 69. (List of the owners of mill privileges on Honeoye Creek, Hemlock outlet, and Canadice outlet, in relation to the matter of obtaining options on the damages to the various mill privileges.) (Or 15-2.1.)

Fifteenth Annual Report of the Executive Board of the City of Rochester, N. Y., for the Year Ending April 5, 1891, p. 82. (List of owners of mill privileges from whom options have been secured.) (Or 15-2.1.)

Tenth Annual Report of the Executive Board of the City of Rochester, N. Y., for the Year Ending April 5, 1886, p. 90. (Awards made for damages to mill powers on Hemlock Lake outlet and Honeoye Creek.) (Or 15-2.1.)

Eighth Annual Report of the Executive Board of the City of Rochester for the Year Ending April 7, 1884, p. 28. (Or 15-2.1.)

Twenty-Third Annual Report of the Executive Board of the City of Rochester, N. Y., for the Year 1898, p. 53. (Or 15-2.1.)

First Annual Report of the Department of Public Works of the City of Rochester for the Year 1900, p. 134. (Or 15-3.1.)

Town of Reading, Twelfth Annual Report of the Water Commissioners for the Year 1902, pp. 15–16. Reading, Mass. Lewis M. Bancroft, superintendent. (Award for damages to the Ipswich Mills, $10 495.77.) (Dc-1310.)

Town of Reading, the Sixteenth Annual Report of the Water Commissioners for the Year 1905, pp. 14–15. (Settlement of the claims of the Norwood and Middleton mills for water diversion was made for $1 102.05 and $4 988.33.) (Dc-1310.)

Fifth Quarterly Report of the Water Commissioners of the City of Providence, January 2, 1871, p. 8. Providence, R. I. The City Engineer. (Purchase of the American Wood Paper Company at Pawtuxet for $50 000 disposes of all known claims for damages in consequence of the proposed diversion of the waters of the Pawtuxet River.) (Dc-136.)

The Third Annual Report of the Water Commissioners of the City of Poughkeepsie for the Year Ending February 1, 1872, p. 10. Poughkeepsie, N. Y. (Awards fixed by a commission of the Supreme Court were, to Messrs. Pelton, $40 000; Charles Swift, $6 000; John G. Parker, $16 000, etc. The awards were accepted with the exception of that to the Messrs. Pelton; after some delay an arrangement was effected with Messrs. Pelton and the mill owners below.) (Dc-132.)

City of Salem, Twenty-Eighth Annual Report of the Salem Water Board to the City Council, December, 1896, p. 8. Salem, Mass. David N. Cook, superintendent. (The claims against the city of Salem from the Ipswich Mills or damages sustained have been settled by the payment of $10 000.) (Dc-513.)

Annual Report of the Syracuse Water Board of the City of Syracuse, N. Y., Year Ending July 31, 1894, p. 21. Syracuse, N. Y. John T. Blaney, superintendent. (Awards in the condemnation cases to acquire eighteen different water power rights upon the outlet of Skaneateles Lake.) (Dc-353.)

Ninth Annual Report of the Syracuse Water Board to the Mayor and Common Council of the City of Syracuse for the Year Ending June 30, 1898, p. 24. (Condemnation of water power rights connected with mill properties upon the outlet of Skaneateles Lake.) (Dc-353.)

Twenty-Second Annual Report of the Water Commissioners of the City of Taunton, Mass., November 30, 1897, p. 21. Taunton, Mass. Henry M. Lovering, commissioner. (The claim of Nemasket Mills for interference with the natural flow of the Nemasket River was settled for $500.) (Dc-158.)

City of Springfield, Twenty-Ninth Annual Report of the Board of Water Commissioners for the

Year 1902, p. 10. Springfield, Mass. Everett E. Stone, chairman. (A settlement of claim of mill owners on the Chicopee River for damages growing out of the diversion of the waters of Jabish Brook in June, 1891, was made during 1902; the aggregate sum of $73 000 was paid.) (Dc-406.)

City of Springfield, Twenty-Sixth Annual Report of the Board of Water Commissioners for the Year 1899, p. 12. (Several claims for land damages caused by diverting the waters of Jabish Brook were settled during 1899 in accordance with jury awards before the Hampshire County Superior Court.) (Dc-406.)

City of Springfield, Twenty-Fourth Annual Report of the Board of Water Commissioners for the Year 1897, p. 8. (Claim for damage by the diversion of Jabish Brook was settled by the award of $3 800 to the Nathan W. Bond estate.) (Dc-406.)

Third Annual Report of the Board of Water Commissioners of the City of Waterbury, p. 6, 1870. Waterbury, Conn. The Secretary. (Several corporations and owners of property on Mad River claimed damages for the taking of water from East Mountain Brook.) (Dc-237.)

Twenty-Ninth Report of the Board of Water Commissioners of the City of Waterbury for the Year 1895, p. 37. (Awards to several manufacturing companies on the Mad River for taking the waters of "Turkey Hill" Brook by the Board of Water Commissioners.) (Dc-237.)

Worcester Water Works, Reports of the Committee on Construction and of the Aqueduct Commissioner for the Year 1864, p. 12. Worcester, Mass. City Engineer. (Expenditure for water rights of seven mill owners was $2 350.) (Dc-431, p. 193.)

Thirty-Fifth Annual Report, Chief Engineer of the Water Department to the Board of Water Commissioners, Wilmington, Del., for the Year 1904, pp. 8, 155, 242. Wilmington, Del. Theodore A. Leisen, chief engineer. (Itemized finding of the Arbitration Commission and full details of the valuation of water power in claims for damages by E. I. DuPont Company, Jos. Bancroft & Sons Co., and Jessup & Moore Paper Co., for the diversion of water.) (Dc-169.)

Annual Report of the Chief Engineer of the Water Department to the City of Wilmington for the Year 1883, p. 5. (The legislature of 1883 passed an act authorizing the purchase, at a cost of $60 000, of all the water rights of "South Long Race.") (Dc-169.)

Report of the Cochituate Water Board to the City Council of Boston for the Year Ending April 30, 1876, p. 7. Boston, Mass. (On December 30, 1875, a settlement was made with the Wameset Power Company, of Lowell, for damages in full by the taking of the water of Sudbury River for the sum of $55 000.) (Dc-489.)

Second Annual Report of the Boston Water Board for the Year Ending April 30, 1878, p. 12. Boston, Mass. (Awards for damages by the taking and diversion of the waters of the Sudbury River to the Saxonville Mills, $175 000, and interest from December, 1876; the Belvidere Woolen Manufacturing Company, $40 000; Charles P. Talbot *et al.*, $76 500; Marshall P. Wilder *et al.*, $16 500.) (Dc-490.)

Final Report of the Water Commissioners of the City of Lawrence to the City Council, p. 87. Lawrence, Mass., 1876. (For the sum of $15 000 the Essex Company abandoned all claims against the city on account of raising the water in the river and relinquished to the city the use of its lands.) (Dc-373.)

Search Made in the Library of the American Society of Civil Engineers, May 25, 1905.

Cost of development and rental of water power in North America in the past six years.

The following references result from an examination of: Transactions American Society of Civil Engineers, Vol. 1 to 63, inclusive; Transactions New England Cotton Manufacturers' Association, Vol. 48 to 80, inclusive; Transactions American Society of Mechanical Engineers, Vol. 1 to 27, inclusive; Engineering Index, Vol. 1 to 5, inclusive; Engineering News, Vol. 1 to 52, inclusive; Catalogue of the Library; Technical Index, American Society of Civil Engineers, May, 1906, to October, 1909, inclusive; Engineering Magazine Index, 1908, to August, 1909, inclusive; October and November, 1909.

ARTICLES GIVING DEFINITE FIGURES.

Niagara Power in Buffalo. I. Electrical World and Engineer, Vol. 44, p. 933, December 3, 1904. (Distribution of electrical energy by the Cataract Power and Conduit Company; cost to consumers, etc.; an article of three pages.)

Hydro-Electric Power Development at and near Joliet, Ill., using Chicago Drainage Canal Water. By Thomas T. Johnston. Journal of the Western Society of Engineers, Vol. 9, p. 295, June, 1904. (A discussion on the value, cost of development, etc., of the water power of this canal.)

The Spier Falls Dam of the Hudson River Water Power Company. Engineering News, Vol. 49, p. 552, June 18, 1903. (Gives the financial resources of the company and a statement of contracts for power with seven different companies.)

An Analysis of the "Commercial" Value of Water Power per Horse-Power per Annum. By A. F. Nagle. Transactions American Society of Mechanical Engineers, Vol. 24, 1903, p. 286. (Gives table of cost, etc., illustrated by examples from different companies; income received, etc., and comparison with cost of steam power.)

Extract of the same. Engineering News, Vol. 49, p. 83, January 22, 1903.

Water Resources of the State of New York. Part II. By George W. Rafter. Water Supply and Irrigation Papers of the United States Geological Survey, No. 25, 1899. Washington: Government Printing Office. (Gives value and selling price of water power in New York state.)

Electric Power Transmission. By J. W. Gore in "Paper on the Water Power of North Carolina," p. 335. North Carolina Geological Survey Bulletin No. 8, 1899, Raleigh, N. C. J. A. Homes, state geologist. (Includes relative cost of direct steam power and electrically transmitted power, with examples of some typical manufacturing plants.)

Report on Water Supply, Water Power, the Flow of Streams, and Attendant Phenomena. By C. C. Vermeule, p. 321, Vol. III of the Final Report of the State Geologist, Geological Survey of New Jersey, 1894. Henry B. Kümmel, state geologist, Trenton, N. J. (Gives relative cost of water-power and rental value per horse-power of the leading water powers of the United States.)

Electrical Equipment of the Consolidated California and Virginia Mining Company, Nevada. By L. M. Hall. Minutes of the Proceedings of the Institute of Civil Engineers, Vol. 152, 1902-03, Part 2, p. 430. (A short abstract from Electrical Review, New York. Vol. 41, pp. 298-302, September 6, 1902. The charge for power is $7 per horse-power per month, only one fourth of the cost of power generated locally.)

Electrical Equipment of the C. & C. Shaft, Virginia City, Nev. By L. M. Hall. Engineering Record, Vol. 46, p. 171, August 23, 1902. (The Truckee River General Electric Company sells power to the various mining companies at $7 per horse-power per month, the amount used being based on a maximum peak load of two minutes' duration.)

The Hydraulic Features of the Chambly Water Power. Engineering Record, Vol. 40, p. 50, June 17, 1899. (The total cost of development, exclusive of electrical machinery, was about $28 per horse-power.)

The Water Power at Holyoke. By Albert F. Sickman. JOURNAL NEW ENGLAND WATER WORKS ASSOCIATION, Vol. 18, p. 337, December, 1904. (The cost to the mills of surplus power is about $23 per year per horse-power; the rate paid for permanent power is something below $5 per year.)

The Chateaugay Water Power in the North Country. Electrical World and Engineer, Vol. 42, p. 831, November 21, 1903. (The rate for motors has been put at $20 per year per horse-power.)

Largest Electric Water Power in Maine. Electrical World and Engineer, Vol. 45, p 675, April 8, 1905. ("It is the intention to attract a very large motor load to the distributing lines in Lewiston and Auburn, and to this end consumers who use a maximum of 20 HP. will be supplied at the rate of $30 per horse-power a year of 3 000 hours of operation, as a flat rate. A consumer who uses 30 HP. or over at maximum load can purchase electric current at a flat rate of $25 per horse-power a year of 3 000 hours.")

The Water Power at Holyoke, Mass. By Horatio A. Foster. Journal Association of Engineering Societies, Vol. 25, p. 67, August, 1900. (Gives cost of development of water power and price to consumers.)

Power Transmission Plant in the Maine Woods. Electrical World and Engineer, Vol. 33, p. 537, April 29, 1899. (A description of the plant belonging to the Cumberland Illuminating Company of Portland, Me., and the price charged for the power, etc.)

St. Cloud, Minn., Water Power Plant. By F. W. Springer. Electrical World and Engineer, Vol. 34, p. 481, September 30, 1899. (Price of renting the water power, etc.)

The Catawba River Power Development near Rock Hill, S. C., I–II. By C. A. Mees. Engineering Record, Vol. 50, pp. 114, 129, July 23, 30, 1904. (Cost of development was $110 per horse-power.)

Cross Country Line at Lewiston, U. S. A. Minutes Proceedings Institute of Civil Engineers, Vol. 138, p. 557, 1898–99, Part 4. (A very short abstract from article in the Electrical World, Vol. 33, 1899, pp. 255–258; power for the railway is obtained from falls near Brunswick, where 1 000 HP. has been leased for $10 000 per annum.)

ARTICLES CONTAINING ESTIMATES.

Modern Turbine Practice and Water Power Development. II. By John Wolf Thurso. Engineering News, Vol. 49, p. 26, January 8, 1903. (Gives a few general figures on the cost of water power, intended to apply to conditions at present prevailing in the northern part of the United States and in Canada, including cost of plant and price charged for water power per gross horse-power per year.)

A Project for Developing the Water Power of the Des Moines Rapids. Engineering News, Vol. 46, p. 373, November 14, 1901. (Gives estimates of cost of dams, etc., cost of power station, and results; compares figures with average cost of steam power for location in the upper Mississippi Valley. A long article.)

Notes and Queries. Engineering News, Vol. 48, p. 171, September 4, 1902. (A very short paragraph in answer to the query as to the amount of water power in the United States; the prices to which power is sold vary probably from $10 to $100 per horse-power per annum.)

Work on the Development of Water Power in the Chicago Drainage Canal. Engineering News, Vol. 48, p. 89, August 7, 1902. A very short paragraph. The estimated cost of a plant that will develop 24 000 HP. is about $3 000 000; it is expected to yield an annual income of $600 000.)

The Influence of Electricity on the Development of Water Powers. By F. A. C. Perrine. Transactions of the New England Cotton Manufacturers' Association, No. 75, 1903, p. 101. (On the establishment of central power stations in New England; gives a theoretical value of water power per horse-power.)

Commercial Development of Water Power. By Alton D. Adams. Cassier's Magazine, Vol. 27, p. 152, December, 1904. (Illustrates from actual practice some of the conditions that are met and some of the considerations that govern in the development of water powers for electrical supply from a financial point of view.)

Electricity from Water Power versus Gas. By Alton D. Adams, Cassier's Magazine, Vol. 27, p. 478, April, 1905. (Compares the price of electricity and gas; as low a rate as 1 cent per kilowatt-hour is not infrequently made in the hydraulic-electric system; gives no practical examples of its use: a short article.)

Some Details Entering into the Computation of the Values of Water Powers and the Damages Caused by the Diversion of Water Used for Power. By Charles T. Main. Transactions American Society of Mechanical Engineers, December, 1903. (Contains table of estimated costs per horse-power of water-power plants.)

Developing a Water Power, Elements of Financial and Commercial Success. By Thorburn Reid. Cassier's Magazine, Vol. 26, p. 419, August, 1904. (A theoretical treatment of the subject.)

Cost of Energy in Electrical Supply. By Alton D. Adams. Engineering Magazine, Vol. 24, p. 181, November, 1902. (A comparison of accurate figures from steam and water power stations, showing the influence of local conditions upon the elements of cost.)

Water-Power in Electrical Supply. By Alton D. Adams. Cassier's Magazine, Vol. 23, p. 326, December, 1902. (First cost and subsequent charges connected with development of water power.)

Commercial Analysis of Small and Unprofitable Electric Lighting and Power Enterprises. By William D. Marks. Electrical World and Engineer, Vol. 36, p. 321, September 1, 1900. (Gives income, etc., of several enterprises dealing with small accounts.)

Report on the Development of the Water Power of the Des Moines Rapids of the Mississippi River near Keokuk, Ia., and Hamilton, Ill. By Lyman E. Cooley. Paper. 1901. Published by the Keokuk and Hamilton Water Power Company, Keokuk, Ia. (Gives estimates of the cost of the development of the water power.)

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SEARCH FOR MATERIAL ON "COST OF DEVELOPMENT AND RENTAL OF WATER POWER IN NORTH AMERICA," NOVEMBER 13, 1909.

NOTE. — This is a continuation of Search No. 153. (Original search made May 25, 1905.) These references result from an examination of the following: Engineering Index, 1905 to November, 1909, inclusive; Transactions American Society of Civil Engineers, Vols. 46 to 64, inclusive.

Hydro-Electric Power in Canada. By Cecil B. Smith, member American Society of Civil Engineers. Proceedings American Society of Civil Engineers, Vol. 35, p. 454, May, 1909. (Contains brief data on the rental of water power.)

The Economic Improvement of the Coosa and Alabama Rivers in Georgia and Alabama. By D. M. Andrews, member American Society of Civil Engineers. Transactions American Society of Civil Engineers, Vol. 50, p. 363, Paper 952, June, 1903. (Theoretical.)

The Hydraulic Plant of the Puget Sound Power Company. By Edwin H. Warner, member American Society of Civil Engineers. Transactions American Society of Civil Engineers, Vol. 55, p. 249, Paper 1007, December, 1905. (States that the total cost of work approximates $125 per horse-power, a portion of which is properly chargeable to preparation for the second installation of 20 000 HP., which, when made, will reduce the cost to approximately $90 per horse-power developed.)

Some Engineering Features of the Southern Power Company's System. By J. W. Fraser. Transactions American Institute of Electrical Engineers, Vol. 27, p. 819, 1908. (On the cost and rental of hydro-electric power.)

Southern Water Power Developments. Electrical World, Vol. 50, p. 1241, December 28, 1907. (The Southern Power Company charges $20 per horse-power per year for energy used eleven hours a day, six days in the week.)

Water Power Estimate. In Third Annual Report of the State Water Supply Commission of New York for year ending February 1, 1908, pp. 438, 483, 495. Albany, 1908. State Water Supply Commission, Henry H. Persons, president. (Estimates of cost and profit of water-power development in northern New York.)

Water Storage and Power Development. In Fourth Annual Report of the State Water Supply Commission of New York for the year ending February 1, 1909, p. 161. Albany, 1909. (Estimated cost and possible net annual revenue from undeveloped water power in New York state.)

Cost of Electric Power to Consumers. (Letter.) By Charles L. Jones. Electrical World and Engineer, Vol. 45, p. 350, February 18, 1909. (Cost of hydro-electric power made by the Cataract Power and Conduit Company.)

The Cost of Water Power. By Samuel Webber. Cassier's Magazine, Vol. 8, p. 415, August, 1895.

Electric Power Transmission. By Frederick Darlington. Transactions American Institute of Electrical Engineers, Vol. 25, p. 181, 1906. (Cost of development of water power.)

The Sale and Measurement of Electric Power. By S. B. Storer. Report of the Twenty-Fourth Annual Meeting of the Street Railway Association of the State of New York, 1905–06, p. 62. C. B. Fairchild, Jr., Secretary, 114 Liberty Street, New York. (Refers to hydro-electric power plants. Theoretical.)

Abstract of same. *The Sale and Measurement of Power.* By S. B. Storer. Engineering Record, Vol. 54, p. 495, November 3, 1906; Electrical Age, Vol. 37, p. 129, August, 1906.

The Sale of Water Power from the Power Company's Point of View. By C. E. Parsons. Report of the twenty-fourth annual meeting of the Street Railway Association of the State of New York, 1905–06, p. 77. (Describes the system of the Hudson River Electric Power Company.)

Abstract of same. Engineering Record, Vol. 54, p. 161, August 11, 1906.

The Ontario Hydro-Electric Power Commission at Ottawa. By J. A. Macdonald. Electrical World, Vol. 52, p. 720, October 3, 1908. (Gives rental of power in the city of Ottawa.)

Contracting for Use of Hydro-Electric Power on Railway Systems. By G. A. Harvey. Report of the twenty-fourth annual meeting of the Street Railway Association of the state of New York, 1905–06, p. 89. (Theoretical; analysis of rental of hydro-electric power.)

Abstract of same. Electrical Age, Vol. 37, p. 211, September, 1906.

Cost of Steam and Water Power in Montana. By M. S. Parker. Journal Association of Engineering Societies, Vol. 15, p. 26, July, 1895. (Gives charges for power at various places.)

The Cost of Niagara Power in Buffalo. Electrical World, Vol. 31, p. 499, April 23, 1898. (Statement by the Cataract Power and Conduit Company of their rates and reasons for making them.)

Analysis of Proposed Change in Power Contract. By Robert Sibley. Engineering and Mining Journal, Vol. 87, p. 794, April 17, 1909. (A system of penalties for peak loads, introduced by a northwestern water-power company.)

The Analysis of an Hydro-Electric Project. By H. von Schon. Journal Western Society of Engineers, Vol. 13, p. 687, December, 1908. (On the cost and rental of hydro-electric power.)

Hydro-Electric Practice. By H. A. E. C. von Schon, member American Society Civil Engineers, Philadelphia, 1908. J. B. Lippincott. $6 net. (Contains chapters on cost of development of hydro-electric power and value of project and presentation.)

Water Power Engineering, the Theory, Investigation, and Development of Water Powers. By Daniel W. Mead, member American Society of Civil Engineers, p. 646. New York, 1908. McGraw Publishing Company, 239 W. 39th Street. $6. (Contains a chapter on the cost, value, and sale of power.) (Dd-71.)

Water Power Development in the National Forests, a Suggested Government Policy. By Frank G. Baum. Transactions American Institute Electrical Engineers, Vol. 27, p. 475, 1908. New York, 1909. Ralph P. Pope, secretary, 33 W. 39th Street. (Theoretical article.)

Notes on Hydro-Electric Developments. By Preston Player. New York, 1908. McGraw Publishing Company, 239 W. 39th Street. $1 net. (Costs and profits of water-power development.) (Dd-70.)

The Cost of Hydro-Electric Power Development in the Province of Ontario. Engineering News, Vol. 58, p. 669, December 19, 1907. (Table of estimated cost of hydro-electric power development and annual charges per horse-power.)

Relation of Load Factor to Power Costs. By E. W. Lloyd, C. A. S. Howlett, and J. M. S. Waring. Journal Western Society of Engineers, Vol. 14, p. 241, April, 1909. (Theoretical.)

Some Fundamental Principles Underlying the Sale of Electrical Energy. By Clarence P. Fowler. Electrical World, Vol. 50, p. 456, September 7, 1907. (Discusses rental of hydro-electric power.)

Notes on Design of Hydro-Electric Power Stations (with reference to the Influence of Load Factor). By David B. Rushmore. Transactions American Institute of Electrical Engineers, Vol. 25, p. 145, 1906. (Cost and value of efficiency in power plant designing, general discussion.)

The Relation of Load Factor to the Evaluation of Hydro-Electric Plants. By S. B. Storer. Transactions American Institute of Electrical Engineers, Vol. 25, p. 139, 1906. (Theoretical.)

Abstract of same. Electrical World, Vol. 47, p. 669, March 31, 1906.

Relation of the Federal Government to Undeveloped Water Power on Navigable Streams. By J. E. Sirrine. Engineering Record, Vol. 60, p. 207, August 21, 1909. (Discusses in a general way the cost of developing water power.)

A Discussion of Various Methods of Charging for Electric Energy. By E. Richards. Transactions of the Engineering Society, University of Toronto, Vol. 20, p. 57, 1906–07. G. H. Moody, secretary, Toronto, Ontario, Canada. 50 cents. (The various methods of charging for hydro-electric and other plants and their effects upon load factor; theoretical.)

A Proposed Dam and Water Power on the Mississippi River at Keokuk, Ia. By Lyman E. Cooley. Journal Western Society of Engineers, Vol. 7, p. 10, February, 1902. (Estimated costs of developing a water-power project.)

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SEARCH FOR MATERIAL ON VALUATION OF WATER POWER, NOVEMBER 15, 1909.

NOTE. — Search No. 291 brought up to date.

Storage and Pondage of Water. By Joseph P. Frizell, member American Society Civil Engineers. Transactions American Society of Civil Engineers, Vol. 31, pp. 29, 552. January, May, 1894. (On the valuation of water power.)

The Cost of Steam Power. By Charles E. Emery, member American Society of Civil Engineers. Transactions American Society of Civil Engineers, Vol. 12, p. 425, November, 1883. (In a suit respecting the loss of power by the diversion of water, damages were claimed by the mill owners based on the cost of purchasing, operating, and maintaining at each mill a small engine, and a complete independent steam plant.)

Calculations of the Mean Horse-Power of a Variable Stream and the Cost of Replacing the Power Lost by a Partial Diversion of the Flow. By William H. Grant, member American Society of Civil Engineers. Transactions American Society of Civil Engineers, Vol. 22, p. 389, June, 1890. (In regard to claims of property owners for diversion of part of the waters of the Bronx River.)

The Value of Water Power. (Editorial.) Engineering Record, Vol. 33, p. 597, May 9, 1896. (Two columns.)

An Analysis of the "Commercial" Value of Water Power per Horse-Power per Annum. By A. F. Nagle. Transactions American Society of Mechanical Engineers, Vol. 24, p. 286, 1903. (With discussion.)

Abstract of same. Engineering News, Vol. 49, p. 83, January 22, 1903.)

Computation of the Values of Water Powers and the Damages Caused by the Diversion of Water Used for Power. By Charles T. Main. Transactions American Society of Mechanical Engineers, Vol. 26, p. 68, 1905. (Gives definitions of value and damage and method of determining value.)

Abstract from the Report of the Water Commissioners, Troy, N. Y., Damages to Mill Powers. By William G. Raymond. JOURNAL NEW ENGLAND WATER WORKS ASSOCIATION, Vol. 13, p. 152, December, 1898. (On the method of estimating value of damages.)

A Method of Estimating the Loss of Water Power in a Stream by Taking Water Therefrom for a City Supply. By L. M. Hastings. JOURNAL NEW ENGLAND WATER WORKS ASSOCIATION, Vol. 7, p. 187, June, 1893. (Discussion on the value of the water power.)

Abstract of same. Engineering Record, Vol. 27, p. 296, March 11, 1893.)

Cost of Steam and Water Power. By Charles T. Main. Transactions American Society of Mechanical Engineers, Vol. 11, p. 108, 1889. (On the value of water power; no reference to condemnation proceedings.)

Comparative Cost of Steam and Water Power. By Charles H. Manning. Transactions American Society of Mechanical Engineers, Vol. 10, p. 499, 1889. (On the value of water power.)

The Value of a Water Power. By Charles T. Main. Transactions American Society of Mechanical Engineers, Vol. 13, p. 140, 1891. (On the method of estimating the value of water power with relation to condemnation proceedings.)

On the Value of a Horse-Power. By George I. Rockwood. Transactions American Society of Mechanical Engineers, Vol. 21, p. 590, 1900. (On the dispute between the city officials of Worcester and the mill owners on the loss of power by the diversion of water for the Worcester reservoir.)

Relation of Steam to Water Power. By James G. Hill. Transactions New England Cotton

Manufacturers' Association, Vol. 65, p. 333, 1898. (Contains a table giving yearly cost of one horse-power of water.)

Valuation of Manufacturing Property for Taxation. By Charles T. Main. Transactions New England Cotton Manufacturers' Association, Vol. 67, p. 108, 1899. (Contains data on the method of determining the value of water power.)

Water Power, Its Measurement and Value, with Data Respecting Damages Awarded. By George A. Kimball. Journal Association of Engineering Societies, Vol. 13, p. 71, February, 1894. (Paper read before the Boston Society of Civil Engineers. Some of the facts presented in evidence before the commission to award damages in the city of Waltham, Mass.)

Water Power at Niagara Falls. By Samuel McElroy. Journal Association of Engineering Societies, Vol. 4, p. 395, September, 1885. (Estimation of the value of water power by commissioners to award damages.)

Water Power. In Geological Survey of New Jersey. Final Report, Vol. 3. By Henry B. Kümmel, State Geologist, Trenton, N. J., 1894. (Data on the cost of water power.)

Nashua River Paper Company v. *Commonwealth of Massachusetts*, 4 volumes, Boston, 1901. Wright & Potter Printing Company, 18 Post Office Square. (On damages to be awarded for drawing off the water flowing by the plaintiff's mills.) (Dd-38.)

Report on the Water Power of the Rock River at Sterling and Rock Falls, Ill., and the Probable Effect on the Power of the Diversion of Water for Feeding the Illinois and Mississippi Canal. By Daniel W. Mead, Chicago, Ill., 1904. The author, First National Bank Building. (Gives the value of water power destroyed by diversion of water.) (Dd-44.)

Kettle Brook and Blackstone Valley Mill Owners, Petitioners v. *City of Worcester*, 5 volumes, Worcester, 1899. (Final arguments in a suit on the loss of power from the diversion of water.) (Dd-40.)

Boston Belting Company v. *City of Boston*, 39 volumes, pamphlets, Boston, 1899. (Suit relates to the diversion of water from Stony Brook and the value of the water power.) (Dd-39.)

Holyoke Water Power Company v. *City of Holyoke*, 20 volumes, Boston, 1899. George H. Ellis, 272 Congress Street. (Suit in regard to the value of the water power.) (Ia-28.)

Value of New England Water Power. (Editorial note.) Engineering News, Vol. 43, p. 49, January 25, 1900.) Contains a table taken from the Providence *Journal.*)

Water Power of Caratunk Falls, Kennebec River, Maine. By Samuel McElroy. Transactions American Society of Mechanical Engineers, Vol. 17, p. 58, 1895–96. (On the relative cost of steam and water power.)

Abstract of same. Engineering News, Vol. 34, p. 422, December 26, 1895.

Computation of the Value of Water Powers and the Damages caused by the Diversion of Water Used for Power. By Charles T. Main. JOURNAL NEW ENGLAND WATER WORKS ASSOCIATION, Vol. 21, p. 214, September, 1907. (Contains a table of estimated costs per horse-power of water power plants.)

Damages Caused by the Diversion of Water Power. By Clemens Herschel. JOURNAL NEW ENGLAND WATER WORKS ASSOCIATION, Vol. 21, p. 241, September, 1907. (On methods of estimating market value of water power.)

Water Rights. By Richard A. Hale. JOURNAL NEW ENGLAND WATER WORKS ASSOCIATION, Vol. 21, p. 248, September, 1907. (The discussion of this paper relates to the valuation of water power.)

Notes on Design of Hydro-Electric Power Stations with Reference to the Influence of Load Factor. By David B. Rushmore. Transactions American Institute of Electrical Engineers, Vol. 25, p. 145, 1906. (The discussion of costs is confined to general principles; definite values are not given.)

Electric Power Transmission. By Frederick Darlington. Transactions American Institute of Electrical Engineers, Vol. 25, p. 181, 1906. (Cost of developing and maintaining hydro-electric power employed in mill work in comparison with steam power.)

The Relation of Load Factor to the Evaluation of Hydro-Electric Plants. By S. B. Storer. Transactions, American Institute Electrical Engineers, Vol. 25, p. 139, 1906. (Contains diagrams giving comparative cost of steam and hydro-electric plant.)

The Sale and Measurement of Electric Power. By S. B. Storer. Street Railway Journal, Vol.

27, p. 1018, June 30, 1906. (Contains diagrams giving methods of plotting costs and price, per horse-power per year, of steam or hydro-electric power.)

The Cost of Hydro-Electric Power Development in the Province of Ontario. Engineering News, Vol. 58, p. 669, December 19, 1907. (Tables of cost from the report of the Hydro-Electric Power Commission of the Province of Ontario.)

The Value and Design of Water Power Plants as Influenced by Load Factor. By Frederic A. C. Perrine. Journal of the Franklin Institute, Vol. 162, p. 269, October, 1906.

Sale of Water Power from the Water Power Company's Point of View. By C. E. Parsons. Street Railway Journal, Vol. 27, p. 1023, June 30, 1906.

Cost of Generating Electric Power. By F. A. Griffin. Street Railway Journal, Vol. 26, p. 1142, December 30, 1905. (Gives diagram of maintenance of generating station and states that the cost of generating power by water can be found from the diagram by eliminating the cost of coal.)

The Developments of Water Power in the Province of Ligure, Italy. Electrical Review, London. Vol. 59, p. 454, September 21, 1906. (Gives cost of developing the power.)

Hydraulic Developments as Related to Electric Installations. By William B. Jackson. Journal of the Western Society of Engineers, Vol. 8, p. 312, June, 1903. (Entirely theoretical.)

Modern Turbine Practice and Water-Power Plants, p. 196. By John Wolfe Thurso, New York, 1905. D. Van Nostrand Company, 23 Murray Street. $2 net. (Contains one page on cost of water power.) (Dd-53.)

The Comparative Cost of Steam and Hydro-Electric Power. By William O. Webber. Engineering Magazine, Vol. 33, p. 889, September, 1907.

Hydro-Electric Power v. *Steam for Industrial Purposes.* By H. von Schon. Engineering Magazine, Vol. 33, pp. 34, 184, 353, April, May, June, 1907. (A comparison of costs of hydro-electric and steam power in developed and undeveloped plants.)

Contracting for Use of Hydro-Electric Power on Railway Systems. By G. A. Harvey. Street Railway Journal, Vol. 27, p. 1016, June 30, 1906.

Electric Transmission of Water Power, p. 1. By Alton D. Adams. New York, 1906, McGraw Publishing Company. $3. (Two chapters on water power and its utility in electrical supply relate to the cost of water power.) (Hc-66.)

Design and Construction of Hydro-Electric Plants, p. 45. By R. C. Beardsley. New York, 1907, McGraw Publishing Company. $5 net. (Contains four pages on the relation of pondage and reservoirs to the valuation of power.) (Dd-56.)

High-Tension Power Transmission, Vol. 1, p. 434. New York, 1905, McGraw Publishing Company. $3. (A comparison of the cost of steam and water power. In discussion on "Maximum Transmission Distance." By Ralph D. Mershon. Read before the American Institute of Electrical Engineers.) (Hc-68.)

The Adjustment of Diversion Damages by Storage Compensation. By Robert E. Horton. JOURNAL NEW ENGLAND WATER WORKS ASSOCIATION, Vol. 22, p. 334, September, 1908.

Proposed Compensation in Kind for Water Diverted for the Supply of Norwich, Conn. By Hill, Quick, and Allen. Engineering News, Vol. 45, p. 381, May 23, 1901. (Outline of a plan for compensating mill owners.)

An Important Decision Upon a Mill Owner's Suit to Collect Damages for the Diversion of Water. By Louis L. Tribus. (Letter.) Engineering News, Vol. 43, p. 228, April 5, 1900. (Gives text of decision in the case at Newton, N. J.)

The Appraisal and Depreciation of Water Works and Similar Properties. By William H. Bryan. Journal Association Engineering Societies, Vol. 39, p. 336, December, 1907. (Methods of valuation.)

Compensating Reservoirs for Gravity Water Supplies in Lieu of Compensation for Riparian Rights and Its Legal Aspects. By S. E. Babcock. Proceedings American Water-Works Association, Vol. 18, p. 101, 1898.

The Value of Water. By Alton D. Adams. Municipal Engineer, Vol. 37, p. 77, August, 1909. (Decision of the Massachusetts court as to the general rule of compensation where water is taken under legislative authority for public use.)

Notes on Newton, N. J., Water-Works Construction and Litigation. By Louis L. Tribus. JOURNAL NEW ENGLAND WATER WORKS ASSOCIATION, Vol. 23, p. 145, June, 1909. (Decision of court as to valuation of water power diverted for Newton, N. J., water works.)

DISCUSSION.

MR. LEONARD METCALF.* In comment upon the work of the committee, it may be asked why we took the seventh month in order of dryness as a basis in figuring available power. Our reason was that that figure seems to represent the average practice in New England. At the same time you must bear in mind the fact that the wheel development on any stream at any privilege will depend upon the use to which it is to be put.

I also want to caution you in regard to the use of the figure 1.4 cubic feet per second run-off of water corresponding to the flow of the seventh month arranged in order of dryness, which refers to the maximum wheel development. That does not imply, of course, that you actually get the power corresponding to that flow of water throughout the year. It simply means that you have a wheel installation to utilize that amount of water; you get the power that may be generated from the actual flow in the stream. The average amount will be the power corresponding more nearly to a flow one cubic foot of water per second per square mile of tributary watershed under the conditions prevailing in New England streams.

In regard to the Sudbury River records to which we have referred, we believe that the record of the period up to and including 1897 is more accurate than the later period, for the reasons stated. The water coming from the Nashua River, flowing through the Sudbury basin, has to be measured in and out, and as Boston is now using about one hundred and twenty million gallons of water a day, you can see that an error of one or two per cent. in the measurement of the quantity of water flowing, distributed back on to 75 square miles of the Sudbury River watershed, introduces quite an error. This and the further fact that account is not made of the actual evaporation from the existing water surface of the present basins is the explanation for the negative yields which we have had from this watershed, particularly since the year 1897.

One word in regard to the range of awards for diversion of water per square mile per foot of fall. To tell you that these results range from $2 to $360, or whatever the exact figure is, per square mile per foot of flow does not mean much. But I think when you

* Of Metcalf & Eddy, Consulting Engineers, Boston, and Secretary of the Committee on Awards.

are given the average results, and the results which have been obtained in certain privileges with which you are conversant, you will be able to take the individual results and make a reasonably close estimate of the damages which are likely to accrue in any locality in New England for water diverted. Thus, for instance, you will find on studying these results, for the more remote privileges, and of low fall, which have not been highly developed and are used for grist mills and similar plants, values of from $10 to $15; for a little more specialized use, $25; and taking such uses as we find on Blackstone River in the Kettle Brook and Woonsocket cases, where the award was about $137, we may say that the award is likely to range from $125 to $150 per square mile of tributary watershed per foot of fall. So, after all, I think you will find that the records given you, with the detailed information, are sufficiently specific to enable you to discriminate intelligently between the conditions existing upon your own privilege and those cited by us, and to determine the applicability of the different results given you.

In the case of abandoned and unused privileges, we find that the general results range from $1 or $2 for remote privileges to perhaps $10 to $20 per square mile of tributary watershed per foot of fall for privileges advantageously located, but which have been abandoned.

I think that is all that I wanted to call to your attention. If our report shall assist in keeping you out of litigation, we shall feel amply repaid.

Mr. H. K. Barrows.* The report of this committee is most interesting and a valuable contribution to the records of this Association.

In using only the Sudbury, Croton, and Nashua records of run-off, the committee have very properly stated that their deductions regarding the average discharge of streams in New England are only roughly approximate. It seems to me that this statement should be further accentuated and kept clearly in mind. Perhaps it would be safer to state further that the conclusions of the committee in this respect are based wholly upon the run-off of three streams in southern New England (and New York) which are not

* Of Barrows & Breed, Consulting Engineers, Boston, Mass.

applicable to many other streams in this part of New England to, say nothing of those in the northern New England states.

The measurement of run-off of streams in New England by the United States Geological Survey has been carried on now for several years, and even a superficial examination of their records indicates very wide variations in run-off in different sections of New England.

Thus in the Berkshires of western Massachusetts records have been kept sufficiently long to indicate that a much higher average run-off occurs there than in the Nashua and Sudbury region. The upper Deerfield basin is especially noteworthy in this way, and an examination of precipitation records in that vicinity indicates a decided increase in amount at the higher elevations, thus increasing the run-off of streams heading in this mountain range.

This increase in precipitation with altitude in New England is very well shown by the records kept on the summit of Mt. Washington by the United States Weather Bureau. The mean annual precipitation here over a period of fifteen years was 83.5 inches, or about double that at the lower altitudes. Very high precipitation occurs here in the summer months, and the regimen of streams heading in the White Mountains is decidedly different from that of the Sudbury and Nashua or other streams in southern New England.

In the state of Maine some very good records of run-off have been obtained, which also show marked differences in regimen of flow. Here many of the rivers are affected by storage, and this factor is of great importance in planning water-power developments.

To show in a general way the variation in run-off of New England streams, I have arranged the following tables, which include data at some of the stations of the United States Geological Survey as prepared for a special report to the United States Conservation Commission in 1908, supplemented by data obtained during 1908.*

The stations in Maine have been considered as one group and those in the remaining New England states as a second group.

* From manuscript of Water Supply Paper No. 241, United States Geological Survey, by permission of the Director.

TABLE I.

MEAN YEARLY RUN-OFF AT RIVER STATIONS IN THE STATE OF MAINE, 1900–1908 INCLUSIVE.

Station.	Drainage Area. Square Miles.	Mean Annual Run-Off in Sec. Feet per Square Mile.
Fish River, Wallagrass	890	1.48
Aroostook, Fort Fairfield	2 230	1.89
St. Croix, Woodland	1 420	2.45
Machias, Whitneyville	465	2.28
Penobscot, Millinocket	1 880	1.72
Mattawamkeag, Mattawamkeag	1 500	2.07
Piscataquis, Foxcroft	286	3.00
Kennebec, The Forks	1 570	2.03
Moose, Rockwood	680	1.64
Sandy, Madison	650	1.62
Cobbossecontee, Gardiner	240	1.36
Androscoggin, Rumford Falls	2 090	1.68
Presumpscot, Sebago Lake	420	1.49
(1) Mean of Maine Group		1.90
Maximum		3.00
Minimum		1.36
(2) Mean of Sudbury-Nashua		1.66
Ratio $\frac{(1)}{(2)}$, mean		1.15
" maximum		1.81
" minimum		0.82

TABLE II.

MEAN YEARLY RUN-OFF AT RIVER STATIONS IN NEW ENGLAND, EXCEPTING MAINE, 1900–1908 INCLUSIVE.

Station.	Drainage Area. Square Miles.	Mean Annual Run-Off in Sec. Feet per Square Mile.
Saco, Center Conway, N. H.	385	2.65
Merrimac, Franklin, N. H.	1 460	2.09
Pemigewasset, Plymouth, N. H.	615	2.57
Nashua, Clinton, Mass.	119	1.77
Sudbury, Framingham, Mass.	75	1.55
Connecticut, Sunderland, Mass.	7 700	1.79
Housatonic, Gaylordsville, Conn.	1 020	2.09
Otter Creek, Middlebury, Vt.	615	*1.58
Winooski, Richmond, Vt.	885	*1.76
(1) Mean of group		1.98
Maximum		2.65
Minimum		1.55
(2) Mean of Sudbury-Nashua		1.66
Ratio $\frac{(1)}{(2)}$, mean		1.19
„ maximum		1.60
„ minimum		0.94

The stations in the foregoing tables are not located so as to give a true mean value of the yearly run-off in the two districts considered, as many more stations are needed, with more general distribution, to accomplish this result. The mean value obtained for the state of Maine is better than that for the other district, but the tables are chiefly valuable in showing the great variation in run-off in different portions of New England.

A percentage comparison is made in both cases with the Sudbury-Nashua mean run-off, and the futility of applying the latter records generally to New England drainage areas is very apparent. (The figures of run-off of the Croton River, 1900–1908, are not available. The run-off of the Croton is similar to that of the Sudbury, however, and probably little difference has been occasioned thereby.)

It will be many years before the United States Geological Sur-

* For the period 1900–1906, inclusive.

vey will have obtained records of run-off at a sufficient number of stations in New England to cover all water-power sites, but it should be kept in mind that these data are being accumulated as fast as conditions will allow, and even now data are at hand in many cases which are much better applicable than the time-honored Sudbury-Nashua-Croton records, which, while accurate in themselves, are often used for drainage areas and hydrologic conditions entirely at variance with conditions upon these three drainage basins.

MR. E. L. GRIMES.* I have been engaged in defending my city more or less intermittently in cases for six or seven years, and I fully agree with the conclusion that this committee has come to with regard to getting a standard by which these cases can be adjusted. I find it very difficult, even upon the same stream, to find any two cases which will bear such relation to each other that they can be well compared. Cases are brought sometimes which seem unreasonable and ridiculous. For instance, there is one case I have in mind where an ice company, which simply rented the privilege of cutting ice from a pond fed by a stream, the upper waters of which the city diverts, brought in a claim of $20,000 for the diversion of the water. The water is not sufficiently diverted from the stream to prevent them from cutting as much ice on the pond as usual. They have no rights in the pond except those that they have leased from other parties who can cut them off from the pond at any time they choose.

I occasionally run across some amusing claims which involve new and interesting hydraulic principles. For instance, one of the mill owners insisted that as a result of his observation during a long period of years he knew that he could do more work during the night hours than he could during the day hours, and the reason he gave for it was that the water was heavier at night than it was in the day.

Another case, where I was quite interested to know what the decision of the court would be, was a case where a man owned the bed of a pond. The pond is a natural pond, and the man acquired the bed. He afterward wished to raise his dam, and he acquired the rights of the property owners above him to high-water mark

* City Engineer, Troy, N. Y.

of the proposed new reservoir. The city has taken the reservoir which this man built and the rights which he had acquired. The parties adjacent to this pond, who own the land above the high-water mark, all claim riparian rights in this water. I am interested to know whether the parties about the pond have any riparian rights, and if they do have when the pond is at high-water mark,— if they have riparian rights then, due to the fact that their property abuts upon the water, — whether they would have any such rights if the water was drawn down a foot or two, leaving a strip of land between their property and the water.

MR. R. E. HORTON (*by letter*).* This general subject is of great interest and importance both to water-works and water-power engineers. To a layman it would certainly appear that there was a very wide discrepancy in the values of water powers arrived at in different cases, and furthermore that there was, as a rule, just as much difference between the values awarded for water powers in condemnation proceedings and the prices at which sales and transfers actually take place between private parties. The writer has frequently been asked the question by a prospective client, "How much is a horse-power worth?" It seems to me that a proper reply to this sort of question is, Yankee fashion, to ask another question, as, for example, "How much is a farm worth?" In other words, there is no fixed value applying to all water powers any more than there is any one fixed value applying to all farm lands, and for the same reasons.

In a paper presented before the American Water Works Association in 1909, and which will shortly be published in their proceedings, the writer has attempted to correlate the different conditions commonly arising in questions of valuation of water power, and to deduce some general conclusions therefrom. Inasmuch as the writer's views will be shortly presented in this form it does not seem advisable to elaborate them here to any extent. One principle which has been very helpful to the writer in arriving at a proper basis of valuation may be briefly stated as follows: The value of a horse-power of water power at any place is closely related to the market value in that locality of whatever form of power is sufficiently common or so extensively used as to generally

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predominate and rule the market. For example, in a region where water power was very scarce, and extensive manufacturing was carried on almost exclusively by steam power, a water power might be of great value. On the other hand, an entirely similar water power located in a region where large water powers were abundant, where nearly all manufacturing was carried on by water power, and where there was still remaining undeveloped power, in such a case the value of the water power might be very much less than in the former case. In the former case the value of the water power might very probably be arrived at by estimating the cost of substituting steam therefor. In the latter case the cost of substituting steam in place of the water power would have little or no bearing on the question. It seems to the writer that many experts have made a mistake by applying the method of steam substitution to the estimation of water-power values in all cases regardless of the attendant conditions. This is one source of the widely discordant values offered by opposing experts in condemnation proceedings. Even if their methods were entirely similar, it could not be expected that experts on opposite sides would agree very closely in their valuations, because there are always many matters of judgment, and not infrequently questions of doubt involving legal interpretation. The expert must, of course, fix his value to meet the legal hypothesis of the attorneys and is, as it seems to the writer, entitled to construe questions of doubt in favor of his client. Finally, it appears to the writer that the valuation of water power, even when subjected to careful, honest investigation by experienced men, is a matter of great difficulty and uncertainty. It does not appear evident how any general method can be formulated that is applicable to all cases. It seems to the writer to be necessary that each case should be made a subject of special study, and that ultimately the matter of valuation resolves itself into a question of good judgment.

MR. ARTHUR T. SAFFORD (*by letter*).* The report of this committee is, I believe, the first attempt to tabulate publicly awards and settlements of this character and bring them down to a uniform basis. I think the members of the committee should be asked to continue their labors and get additional statements, which should

* Consulting Engineer, Lowell, Mass.

be forthcoming from other engineers who will begin to realize the amount of work the committee has already done and the value which will result from these statistics.

The committee has made it perfectly clear that all these figures should be used with great care, and that it is not worth while to attempt to reconcile too many apparent inconsistencies. There is, however, the danger that these statistics may, in the future, attempt to take the place of a careful working out of the conditions affecting the value of water power in new cases; and it may not be out of place in the discussion to call attention to some elements which get undue weight in these cases, and bring out other elements which may help to reconcile the differences pointed out by the committee.

There has been a tendency, I think, on the part of engineers, in cases involving litigation, to produce results based upon the Sudbury, Nashua, or Croton River figures, where no attempt has been made to get at the actual power available at a given mill site, except so far as the estimated average flow in cubic feet per second per square mile has been multiplied by the drainage area, the fall, and a power factor. Sometimes the wettest months are thrown out, but rarely is the flow from year to year followed out; and a statement is made, usually without figures, that in dry weather the twenty-four-hour flow may be concentrated into a smaller number of hours; this statement has been thought sufficient in certain cases to warrant the use of a ratio between twenty-four hours and the working time of the mill, and the ratio used as a factor to more than double the apparent power at the mill. This, I think, is a most dangerous practice, and the result has usually been to derive figures, which were beyond even the wheel development at the mill, which usually comprises one or two spare wheels, and to make the part of the water power diverted, on a reasonable basis of value, more than the entire water power is worth and throw discredit upon all the figures. The same is true of a great many reports upon new water powers, and investors are often absolutely deceived because a moderate price for the water power to be sold is joined with figures of flow and power which are, consciously or unconsciously, padded beyond reason.

There is no reason why this condition should exist because the

facts can be obtained and there is an opportunity to study, not only the figures of flow from drought to freshet and just how the water comes to the mill in the different seasons through the twenty-four hours, but also what use is made of it and what the net result will be, and if the value of the power is based upon what may be called the permanent power at a fair price for power for each kind of industry, and a distinction made between this and surplus power, not only will the figures be reasonable ones, but a tabulation of these awards such as we have from the Committee on Awards would probably represent very closely the actual value.

There are at least four different kinds of water powers, each one of which has its own peculiar elements of value, but which cannot very well be classed together, under any consideration of power. The same stream, moreover, at its different water power sites will gain or lose elements of value which will affect its total value materially. The four classes I have in mind particularly are as follows:

1. A water power on a stream like Winnepesaukee River, in New Hampshire, or the outlet of Sebago Lake, in Maine, where the storage is so great that, excepting in very dry years, the power is practically continuous without drought or freshet conditions. The best use of such a power is twenty-four hours continuously.

2. Water power for twenty-four hours continuously on a large stream like the Connecticut River, at Bellows Falls, Vt. In this case the river is practically without storage and, until recently, without large mill ponds. This condition carries with it extreme freshets and droughts.

3. Water power on a large stream like the Merrimac River at Lowell, Mass., and the Hudson River at Spier Falls, N. Y., where there is moderate storage and the pondage is sufficient to store the dry weather flow during the one hundred and sixty-eight hours in the week for use in something less than seventy-two hours. This condition carries with it moderate freshets and droughts.

4. Water power on a small stream like the Concord River at Lowell, Mass., where the water is sent down from one water power to another through small mill ponds and where the power is not constant. This particular stream has little deep storage, but is not subject to great freshets on account of swamps.

These four examples are given merely to bring out some of the differences which go to make power at the different mill sites; and the computations given are carried one step further than the figures given in the report of the committee, in order to introduce the element of time and show a product by the number of hours in which the power can be used. I have used in each case not an extreme minimum, but a period when the particular power was actually tested out at a very low time, and the figures are actual ones. The calculations with some conditions affecting the flow and power are as follows:

1. Sebago Lake, Maine: Drainage area, 420 square miles; storage capacity, said to be 7 500 000 000 cubic feet; ordinary use for power, twenty-four hours; flow for March, 1905, 343 cubic feet per second, or 0.817 cubic feet per second per square mile of drainage area.

The power for a day "per square mile per foot fall" would be 0.817 c.f.p.s. × .085 (power factor) × 24 hours = 1.667 h.p. hours.

2. Connecticut River at Bellows Falls, Vt.: Drainage area, 5 211 square miles; storage capacity, practically none; pondage, practically none; ordinary use for power, twenty-four hours; flow for August, 1909, 1 470.9 cubic feet per second, or 0.282 cubic feet per second per square mile of drainage area.

The power for a day "per square mile per foot fall" would be 0.282 c.f.p.s. × .085 (power factor) × 24 hours = 0.575 h.p. hours.

3. Merrimac River at Lowell, Mass.: Drainage area, 4 097 square miles; storage capacity, 5 000 000 000 cubic feet in Lake Winnepesaukee and other lakes; pondage, 200 000 000 cubic feet; ordinary use, ten to twelve hours; flow for August, 1909, 4 519.5 cubic feet per second, or 1.103 cubic feet per second per square mile of drainage area.

The power for a day "per square mile per foot fall" would be 1.103 c.f.p.s. × .085 (power factor) × 10 hours = 0.937 h.p. hours.

4. Concord River at Lowell, Mass.: Drainage area, 376.5 square miles, including Sudbury River; 301.3 square miles, excluding Sudbury River; storage, practically none below Sudbury River; pondage, practically none; ordinary use, ten to twelve hours; flow for August, 1909, 79.5 cubic feet per second, or 0.264 cubic feet per second per square mile of drainage area.

The power for a day "per square mile per foot fall" would be 0.264 c.f.p.s. × .085 (power factor) × 10 hours = 0.224 h.p. hours.

When the estimate of power is based upon average figures, the differences are not nearly so marked; these figures are not, however, given as estimates of power, but simply to bring out the effect of storage and pondage or the lack of them.

The four examples cited vary from a figure of 1.667 horse-power hours per day "per square mile per foot of fall" in the case of Sebago Lake to 0.224 horse-power hours in the case of the Concord River, the first named being more than seven times the other. Certainly when in the future most water powers are to be valued by their ability to produce a certain number of continuous horse-power or kilowatt hours at all times, it is fair to say that the drainage area, the flow per square mile, and the fall are not more important for estimating the power for commercial purposes at any given mill site than the storage and the pondage, and the value whether for purchase, sale, or assessing damages should not be complete without these other elements. This suggestion is not new and I do not mean that heretofore these elements have been entirely neglected; but it seemed wise in this discussion to again emphasize them so that they would not be lost sight of in the future.

THE UNDERLYING PRINCIPLES GOVERNING RIPARIAN WATER RIGHTS AND DIVERSION SUITS.

BY CHARLES F. CHOATE, JR., ESQ., BOSTON.

[*Read December 8, 1909.*]

It has been suggested that I read a paper as introductory to the discussion of the subject considered in the report made by the committee which has been investigating the subject of awards both by settlement and as the result of litigation for takings of water power. I take it that the first general matter to call to your attention is the nature of the right which a riparian owner possesses.

A man who owns land through which a stream of water flows has a right, which is incident to his ownership of the land, not to the water as property in and of itself, but a right to have that stream of water flow as it would flow under natural conditions, and to make such use of it while it passes through his land as it is possible and practicable to make without interfering with a similar right that is possessed by his next neighbors below him. That is a pretty broad and general definition of the right of a riparian owner, and there must be latitude in it, because the law is not an exact science, for it attempts only to give to individual human beings who may be possessed of different kinds of property those rights which common sense suggests they should be given.

It does not mean very much to say that a man is entitled to have a natural stream flow through his land as it naturally flows, because under present conditions of population and civilization there are many things which interfere, and have interfered, with the natural flow of streams, and which make their flow, as they exist to-day, different from what it was when the country was in a state of nature, as it were. For instance, the building of cities upon the banks of rivers undoubtedly changes to a very large degree the quantity of surface water that is contributed to the flow of any stream in that particular area, both in amount and

in the time when it is contributed, and in the place where it is contributed. The building of walls along the sides of streams must necessarily make a difference. The building of mills and dams upon streams, of course, makes a difference. But the meaning of that principle of law is that, taking the thing by and large, an owner of land through which a stream flows is entitled, as nearly as it is possible to obtain it, to the uninterrupted ordinary flow of the stream under the conditions which have naturally grown up along the borders of that stream. He has a right to use the water itself, that is, to consume the water itself, provided that his consumption does not materially diminish the quantity of water that is flowing in the stream. He has a right to divert it temporarily for irrigation or power or other purposes on his own land, provided he returns it to the stream substantially undiminished in volume or quality. He has the right to make use of it for ordinary domestic purposes. The little consumption, comparatively, that results from using the waters of the stream for a garden and for the ordinary purposes of agriculture, or for watering cattle, is so slight that the law does not recognize it as being an amount which in diminution of the volume of the water in the stream should be noticed, and for those purposes he has a right to use it.

Of course the most essential thing which he has the right to use it for, from an engineer's point of view, is for the development of power. It was long ago said, and is probably as true to-day as it was then, that the power that is incident to the ownership of any particular piece of land through which a stream flows is only the difference in level between the point where the stream enters the owner's land and the point where it leaves it. That, undoubtedly, is the natural right; the fall that exists upon a man's own land is all that under natural conditions he has a right to the enjoyment of. He may increase that right by two means: One by taking advantage of legislation, such as our Mill Acts, which give a man a right to erect a dam and to flow land not belonging to him above him, provided he does not interfere with anybody else's earlier established mill right, and pays damages for the flowage excess; and, secondly, he may increase his natural rights by what is called prescription, that is, by doing something which interferes with

somebody else's natural right for a period, usually twenty years or longer, so long that the law will presume that that right which he is claiming and exercising has been granted to him. If, for instance, he erects a dam upon his own land and flows not only his own land, but his neighbor's, and continues to keep that dam up and claims a right to keep it up and to flow his neighbor's land above him for twenty years, the law in most instances, without other explanation, would say that he had acquired the right to do it. So that, in addition to his natural right to the fall that exists upon his own property, he may increase the volume and value of the right that he possesses either by taking advantage of the provisions of the Mill Acts, or by exercising, under a claim of right, privileges or advantages which in time will grow into a right which he will possess himself.

Rather interesting questions arise relative to the extent of a man's right to the enjoyment of power where a number of mill privileges, dams, or reservoirs exist upon the same stream. Suppose, for instance, a stream which furnishes power, which has half a dozen successive mill rights one below the other. Of course, the man lowest down enjoys the storage which is accumulated by those higher up. If those higher up run their mills during the same period of the twenty-four hours that he does, he gets the accumulation without any expense to himself, and a number of cases have arisen in comparatively recent times which have dealt with the question of the right of the upper and lower proprietors. For instance, under modern conditions, where electricity is being manufactured, a man often wants to run his mill, his power, or his wheel either the whole of the twenty-four hours or during the night time, when the ordinary course is to use the power during the daytime, and the question has arisen between a man lower down the stream, whose business demands the use of water power during, say, ten hours of daylight, and some one up the stream who wants either to run his mill the whole twenty-four hours or to hold up the water during the daytime for accumulation for use simply during the night.

The rights of a riparian owner under those circumstances seem to be these: in the first place, the bottom principle which I have tried to describe to you is pretty strictly adhered to by the courts,

namely, that a man has the right to the natural flow of the stream, and he is not obliged, for the benefit of anybody lower down the stream, to hold up the water for any part of the twenty-four hours; if he sees fit to use it and let it down. For instance, if a man at the head of the stream, who has got a reservoir, desires to run his mill twenty-four hours a day, a man lower down, who only wants to run his mill ten hours a day, cannot compel the upper proprietor to keep the water up during the night time so that he may have the benefit of it below during the day.

A different question often arises where the mill owners lower down on the stream have businesses which require them to run their mills in the daytime, and those who have mills higher up have businesses which make it desirable for them to run their mills in the night time. Could, then, an upper proprietor hold up the water of the river during the daytime and let it down only at night, when it would not be of any value to those lower down the stream, and not let it down during the hours when the mills downstream find it necessary to do their work? While that question has not been definitely decided anywhere in New England that I know of, the decisions have pointed pretty strongly to the conclusion that that situation is to be governed probably by the established usage of the community. And I take it that that after all means very little more than the advantage of the greater number of persons. If, for instance, there were six or seven privileges on the river, and six of those lower down consisted of mills that wanted to run only during the ten hours of the day, and the one higher up wanted to run only at night, I think the probability is that the court would say he did not have the right to hold up the stream during the ten working hours of the day and let down the water only during the night time; that while he would be permitted to run his mill at night, if he saw fit, he would also be required to let the water down during the daytime.

So it comes pretty much, you see, to the bottom principle, that, subject to the usages which have been made of streams for purposes of water power during the workaday hours of the ordinary man's life, a riparian owner is entitled to have the water of the stream come to him about as nature provided that it should come. He is entitled, however, if he builds a dam, to hold up

the water until he gets a head, provided that that does not mean an extraordinary or unusual limitation of the supply below. This is, perhaps, an instance where the law cannot be exact. If a mill owner should erect his dam and build it at the very driest time in the summer, when the flow in the stream was small, and then undertook to hold up all the water in the stream until he could get a head, so that for a number of days or weeks all those below did not get any, it is exceedingly probable that the courts would say that he had exceeded his rights. But ordinarily, unless such action would result in an unusual reduction of the flow, he is entitled, after he has built his dam, to hold the water up until he has accumulated a head.

Of course the man lower down the stream, while he has not got a right to have those higher up store water for him, does enjoy the advantage which the existence of those reservoirs above him inevitably gives to his site. His case is analogous, for instance, to that of a land owner on a public street. A man who owns the property next to a hotel hasn't any right, as matter of right, to have anybody else maintain buildings or carry on business in that vicinity. Every other owner, if he wants to, can tear his building down and move away and carry on his business somewhere else. But in ascertaining what the value of property on such a street is, the fact that other lots adjoining will, in all probability, for many years be used for business purposes, is one of those things that goes to make his property valuable. So with a mill owner down the stream, the probability that those above him will continue as far ahead as any one can see to take advantage of the power that the stream affords, and use the water and store it in the way that they are accustomed to do, is one of those things which does give, not as matter of right, but as matter of advantage of position, value to the property of the mill owner lowest down.

There is but one way, of course, in which the possessor of riparian rights can be deprived of them, and that is by the exercise of the power of eminent domain, — the power which is given to municipalities or water companies, or exercised by the state when it steps in and takes possession of a stream and undertakes to divert the water flowing in it. And that power can be exer-

cised in two ways. It either can be exercised by the filing of a paper in some registry defining exactly what is taken, when the measure of a man's right to damages is absolutely described by the paper that is filed; or, secondly, the right can be exercised without filing a paper, but simply by the act of diverting the water. The result that follows is apt to be slightly different, according as the right is exercised. If it is exercised by the filing of a paper description, of course the extent to which the water is taken is clearly defined. If it is exercised only by an act, as, for instance, the introduction of a pipe and the diversion of water, the rule is that only so much water is taken as is reasonably necessary for the purposes specified by the legislature in its grant to the town or the water company of the right to take water.

Where, for instance, a town is granted the right by the legislature to take water for a municipal supply from a particular stream, and it is not specified that the town may take the entire supply, the rule is that only so much as will reasonably be necessary for the requirements of the town is to be deemed as taken. That often has an unfortunate result, because no one can tell with any degree of accuracy what the needs of the future will be, and the usual course has been to require the filing of a paper which shall define exactly what is taken. That is far more satisfactory to the man whose land or water is taken, and far safer for the municipality or the company which undertakes to exercise the right.

Now what follows when the rights of a riparian owner are interfered with by a taking? Every act of the legislature which gives that authority must, of course, contain a provision for the payment of damages; otherwise, such legislation would be unconstitutional and void. The usual form of remedy given is that the owner shall be entitled to recover whatever damage he may have suffered, to be estimated either by a jury or by a commission; and the rule which the courts have always adopted is that if his entire property is taken he shall be compensated by paying him in money the fair market value of that property; and if a part of his property only is taken, he shall be entitled to the difference in the fair market value of that property between what it

was worth before the taking and what it is worth after the effects of the taking have been fully felt. "Fair market value," while defined by the courts to mean that price which a willing seller who is not forced to sell should receive from a willing buyer who is not forced to buy, has also been defined by the courts to mean the value as it would be established between two men occupying those positions for the most valuable purposes to which the particular property is adaptable. That, you see, gives to the owner of a water power which may not be developed at all, or which may be only partially, and even unwisely and disadvantageously developed, the right to have considered the most advantageous development of what he has for that purpose for which it may reasonably be adapted, always taking into consideration, of course, if he has an undeveloped or unwisely developed power, what it may cost to completely develop it in the most advantageous way.

To illustrate what I mean: Suppose a man has upon a stream an old-fashioned dam and an old-fashioned water wheel, which is not either accumulating as much storage as might in that place be accumulated, or using what he has got to the best advantage or the most economically. He is not necessarily limited to compensation for the loss of the actual power that is being developed over his wheel under those conditions. He is entitled to have the tribunal that settles that question consider what might be done with his power if it were developed in the most advantageous way, also bearing in mind what it might cost to develop it. And so the man who suffers a loss of only a portion of his power is entitled to have the same consideration taken into account in determining how much the value of that thing which he has has been diminished by what has been taken away.

The same rule applies here as applies in all cases of takings of property, and the element which particularly, I take it, interests engineers, comes into play when a portion of a man's water power has been taken away. If a man owns a piece of real estate, consisting of land and a building, and a railroad or a street is laid out through it so that the land and the building are cut in two, of course one of the obvious things to consider in making up one's mind how much he has been damaged is, how much money will

it cost to put that property back as it was before? In that particular case you never could put it back exactly as it was before, but you could restore the building in whole and the land in part to a condition where it would be useful. So in the case of water power, if a man has a power that develops 100 horse-power, and 50 horse-power is diverted, he still has something left which is worth while, and the question is, How shall he be compensated for the loss of that 50 horse-power? There are various ways of proving that which the courts permit.

In the first place, a crude way which is permitted by the courts is to permit persons who are familiar with the value of water powers in the vicinity — familiar, I mean, with actual sales and leases, if there have been such — to testify what they think as matter of expert opinion the damage done has been. The difficulty with that kind of evidence is that it is very, very difficult to obtain. Hardly any two water powers are alike. It is very rarely that water powers in any vicinity, sufficiently alike, which have been dealt in, can be found, and you rarely if ever find a man who is qualified through actual sales of water power or leases of water power, and who is not an expert engineer, who can furnish you with any assistance upon that line.

In the second place, and obviously it is one of the best ways, the courts now permit the furnishing of evidence as to what it will cost to supply a substitute, and that particularly, I take it, is where your profession furnishes its assistance. Witnesses are permitted to testify what the cost will be of substituting that 50 horse-power which has been taken away, — what it would cost to supply 50 horse-power under those conditions, either by steam or by electricity or by gas or oil, or by any other method that may be thought of or discovered. And while the court always tells the jury, or any tribunal always rules, that that is not final or conclusive upon what damages shall be returned, it is a method by which one can ascertain to a very close degree what the real injury has been which has been suffered.

Now a word with reference to the different kinds of testimony which may be advantageously, and are always advantageously, presented by hydraulic engineers. And first, in that part of the field where nobody questions the propriety of the evidence, and

where there isn't very much room for difference in the testimony, the area of the watershed of course must be a thing that can be ascertained with a great degree of accuracy, and upon which two men cannot vary very much; second, the yield of the watershed is also something that can be ascertained with a very reasonable degree of accuracy. It is true that different places and different conditions afford opportunity for the application, possibly, of different standards, and permit the drawing of different conclusions; but in the main there will not be a very wide divergence among those whose profession makes them expert upon that subject.

It is in the step that follows next that professional men seem to differ most, and where the courts have varied and seemed to vacillate to the largest extent. There often occurs a situation where a power is taken which has never been developed but which it is obvious to everybody possesses advantages for development which are very great and valuable. It is exceedingly probable that nowhere in the vicinity have any similar powers been developed, and yet men who are engaged in that kind of business, men who have built and operated mills and carried on the mill business, and men who have been engaged in your profession, know that that undeveloped power has value, and great value, as a mill site. The suggestion was made to me, Is the value which exists in that undeveloped power at that particular place a subject which is within the province of an hydraulic engineer to give expert testimony upon, and, if it is within his province, will the courts permit it? The courts have permitted it, and again they have excluded it, and it is not by any means certain how such testimony will be dealt with when it next arises. For instance, there was a case tried some ten years ago in the vicinity of Boston where the issue was the value of an undeveloped mill site not far from Boston. It was impossible to obtain testimony from anybody in the immediate vicinity who knew about real estate values and who had had any experience which would qualify him to testify about what that power was worth. It was impossible to obtain an hydraulic engineer who knew anything about real estate values, although he could very well determine the amount of power that could be

developed, and could give a very fair and satisfactory judgment upon what that power might be worth under certain conditions.

Under those conditions which I have stated, our Massachusetts court allowed men who had had experience in building and operating mills such as were adapted to being located in that place to testify what the property was worth as a mill site, including as the subject of their valuation not only the water, but land enough for the buildings, land enough for the dam, and, grouping the two together, the land and the power and the site, to say what that property, that combination, was worth as a mill site. Our court said that the admissibility of that sort of proof was a question which should be left to the discretion of the judge who tried the case; that as a rule of practice it ought to be admitted only where it was really a matter of necessity; in other words, where no other satisfactory evidence could be obtained.

Another case some two years later followed the same rule, and the same evidence was admitted, though our Supreme Court used some strictures with reference to it, and suggested that the discretion of the judge who admitted the evidence had better have been exercised the other way.

In the last case, which was the case of the Lakeside Manufacturing Company *v.* Worcester, the same sort of evidence was offered, at this time from exceedingly competent and experienced hydraulic engineers, and the evidence was excluded, and the Supreme Court commended the exclusion of the evidence. So, while the principle has been established that it is admissible within the discretion of the trial judge, the courts have not exactly smiled upon it.

There does not seem to be any reason in principle, however, why such evidence should not be admitted, and why it is not helpful. It seems to me in the trial of cases of this kind it would be a wiser rule if the courts would open the door a little wider and admit that kind of testimony. I entirely agree that an engineer who undertakes to give value to land in a vicinity of which he has no particular knowledge may very well be led astray, and that his opinion on the value of land does not aid the tribunal very much. But it is not to the land or the value of the land that the expert's attention or evidence is directed under those condi-

tions. It is directed to a thing of potential value, as to which he does have specific and expert knowledge, namely, what can be done with the stream of water flowing there under the conditions which he finds, with the addition of land enough along its bank to place the buildings upon for which the development of power may be useful. It is perfectly idle to say that the ordinary testimony of the ordinary real estate expert can do justice to the claim of the owner of that water power, by attempting to say what its value is in accordance with the standards which he is familiar with; that is, what so-and-so's two acres sold for last year, or what some other man's house and lot brought at such and such a time. Those furnish absolutely no guide as to the value of an undeveloped water power.

Therefore, in answer to that suggestion, I should submit that the wiser plan for our courts to follow, and the wiser course for our engineers to advocate, is the admission in evidence of carefully worked out estimates of the value of a situation, consisting really insignificantly of land and very largely of water and of power, which their particular training gives them an opportunity to know the possibilities of the development of and the value of for practical use.

And, after all, the courts, while exercising most scrupulous care to keep within those lines which the principle I have suggested seems to mark out, have practically made exactly the same thing possible by permitting an engineer, in the first place, to testify to the amount of power that can be developed, which it is plain he can testify to; and, in the second place, to the cost of furnishing an equivalent substitute by steam or other means; and by permitting him, or the lawyer who tries the case, to capitalize that cost and to reduce it to the principal sum. You reach exactly the same result, only by a slightly more roundabout way, and when you reach it by that roundabout way there doesn't seem to the court to be anything that does any particular harm.

For instance, you have a stream flowing down over a fall, and your engineer may testify how much power can be developed by raising the dam to a certain height, and how much it would cost to develop that same amount of power by steam. He may tell how much it will cost per year to develop that same amount of

steam, and the calculation by yourself or the tribunal by which that annual cost can be capitalized is a simple one. The result which you have reached, namely, the capitalized value of the power that is running there down the stream, is just the same as if your engineer had been permitted to testify that that mill site, which from my point of view consists almost wholly of the water power, is worth so much money.

DISCUSSION.

MR. LEONARD METCALF.* Mr. President and Gentlemen: I think all of you must have been impressed by the beautifully clear and simple way in which Mr. Choate has presented this matter to your attention to-day. It is not as simple as his explanation seems to make it, and I think in other hands you would have a very different feeling about it. I am led to ask Mr. Choate one or two further questions, or to ask him to touch upon one or two further subjects, which I think would be of particular interest to some men present here to-day.

One is the question as to the possibility of compensation in kind. I believe that our courts have not thus far recognized that principle, although it is possible by means of contract or agreement to arrive at a settlement upon such a basis, if it is done in actual advance of the diversion.

The second matter upon which I should be very glad to hear him say a few words is the effect of diverting, for water-works purposes, water which may subsequently be returned to the stream in the form of sewage above the mill privilege which is bringing a suit. I am not certain whether decisions have conflicted on that point, and whether there are any cases in which recognition of that fact have been taken by the court.

MR. CHOATE. Mr. President and Mr. Metcalf: In reply to the first question, there isn't any equivalent under the law as it stands at present in which compensation can be made except money, and I do not think that there will be any change made in the law by which any other equivalent will be provided for. Of course one may conceive of cases where the party who has the power to

* Of Metcalf & Eddy, Boston.

take can take in such a way that, while by the exercise of the right upon the one hand it inflicts an injury, it can also, by the exercise of the same right, in a way confer a benefit. I can, perhaps, best illustrate it with reference to another subject, as it occurs to me now. A man owns a large tract of land which really cannot be developed unless a street is laid out through it. The municipality lays a street out through the middle, and it takes so much land, and by the taking of so much land it inflicts an injury, but by the opening up of the tract it confers a benefit which may be equal to or even greater than the injury by the loss of the land which is taken for the street. It is possible that in a way that theory of "set-off," as it were, might be worked out in certain water cases. If the powers of the municipality be broad enough, for instance, to take power with one hand and confer rights upon the owner with the other, which he did not have before, I haven't any doubt that the courts would say that the net result must be the thing for which the owner would alone receive compensation.

It is a little difficult for one to give an illustration of it, but that might be done. A mill owner might, possibly, be deprived of a substantial part of his power, and he might by the same authority which took his power be given a right of way in connection with his mill which would be of very great value to him, but the question would still remain whether he could be obliged to take that substitute in part payment, that is, the right of way or other right or easement which might be selected for him by the authority which took away his water power, — whether he could be required to accept that in lieu of money. I think it would be exceedingly doubtful if one could find conditions where that could be worked out, where a man could be paid in kind.

The second question was, What would be the effect if a municipality took water from a stream above and returned practically the same volume into the stream in the shape of sewage above the privilege? I ask you to look at it for a moment from the mill owner's point of view. In the first place, the mill owner has got a right to say, "I am not only entitled to the volume of water that nature intended to flow in that stream, but I am also entitled to have it come to me as clean as nature intended it to." And

there isn't any question, since the decision in the case of Parker *v.* The American Woolen Company, that a land owner can compel an upper proprietor, who insists upon turning any kind of filth into the stream, to desist, but that he is entitled to have the water come to him as clean as — well, I was going to say, as nature intended it to be; and yet the law is not quite that — as clean as the surrounding conditions and the development of the community will permit. But even that does not give a very good definition of the exact state of the law about it. For instance, if the privilege in question is in the country, and the stream flows through pasture land, and some one undertakes to establish a dye works or bleaching mill on the stream, undoubtedly the lower proprietor would be entitled to have that stream come to him as clean as it used to come from the pastures. But if his privilege was in a city, where more or less minute pollution from all sorts of sources has come from time without mind, until its accumulation has really become serious, he is entitled, rather, to have the stream come to him as it was practically before the new source of pollution was introduced.

I appreciate that that is not a very satisfactory statement of it, and yet I think it is about the way the law stands. Each case has practically got to be governed by its own circumstances, and one has got to study what the conditions were when the particular offensive use sprang up. Take, for instance, a case, of which there exist several in this commonwealth, where cities are turning their sewage, their crude sewage, directly and unfiltered into rivers which furnish powers to privileges below. Would a mill proprietor be justified in saying, "I am entitled to have this stream come to me exactly as it flows ten miles above the city, where it is clean enough to drink?" I think undoubtedly he would not. He would be entitled to have it come to him as it would come through a settled territory like that, where there wasn't any active or intentional pollution, and where the pollution, if such there was, was such as was unavoidable from the existence of a thickly settled population in that place. Now, if the municipality above the mill owner says to the mill owner, "I take out so many thousand gallons of water above your privilege, but I return just as many in the shape of sewage when it comes

to you, so that you really have as much power, no matter what the quality of the water is, as you had before," I think the mill owner is entitled to say, "Not at all. I am not required to take sewage to develop my power; I am entitled to have that stream come to me as nearly as possible" under the conditions that I have described, unaffected by intentional or careless or active pollution; and that his first step would be to stop the introduction of the polluting substance, and then, when he had done that, to get after the municipality as hard as he could for the diminution in the flow of the stream.

MR. METCALF. But suppose the community filtered the sewage and returned it to the stream in a purified state?

MR. CHOATE. I think that would present a condition which might leave the mill owner without anything to complain of. Of course, I understand it is perfectly practicable to filter sewage so that there is nothing offensive about the water as it is returned, and the situation would then be like that of the upper proprietor who diverts a part of the river and uses it for irrigation and then puts it back again.

MR. METCALF. In this connection it may be of interest to refer to a case which occurred in Connecticut, where a water company diverted water for its own uses. The water did return to the watershed through the sewers of the town. Suit was brought, and in response to the water company's plea that the water was returned as sewage, and purified at that, the mill owner urged that the water was returned by the city and not by the water company, and that he was entitled to recover from the water company. He could not recover from the city because the city was not diverting the water. The water company paid the damages.

MR. CHARLES W. SHERMAN.* Mr. President, in attempting to secure a little information on awards for this committee, I ran across a little incident of an attempt at compensation in kind in the reports of the trials of the so-called Sudbury River cases, that is at least interesting. The city of Boston, as most of you know, developed the Sudbury River in 1872, or thereabouts, for a portion of its water supply, and the mill owners below on the Concord River and the Merrimac sued for damages. There was a case in

* Principal Assistant Engineer, with Metcalf & Eddy, Boston, Mass.

Billerica, I think, or somewhere in that neighborhood, where there were perhaps six or eight owners on a single water power privilege, each being entitled to a certain portion of the flow of the stream. While the trial of these cases was in progress, the city, as I understand it, at the instigation of General Butler, who was its chief counsel, purchased the entire right of one of those owners to the flow of the stream. They claimed that the proportion to which this owner was entitled was practically the same proportion of the total flow of the stream at that point as had been diverted by the city, and they offered to deed to each of the remaining owners his *pro rata* share of this part which they had purchased in lieu of the water which they had diverted above; thus, as the statement was made, leaving him in the same condition he was before, as far as the total amount of water which he was entitled to have pass through his mill was concerned. The tribunal threw that offer out. It is a little hard for the layman to see why that should have been so, because it seems as though that was not merely a compensation in kind, as we generally understand it, but an actual returning of what was taken away. Perhaps Mr. Choate can explain it.

MR. CHOATE. I don't believe that I can. There are a great many of General Butler's cases which are a little hard to understand.

MR. DEXTER BRACKETT.* I recall to mind another concrete example bearing upon this question of restitution in kind, going back to the construction of the Cochituate works, when reservoirs were constructed by the city of Boston in order to compensate the mill owners on the Sudbury River below for the water taken from Lake Cochituate. At that time it was decided that compensation could not be made in kind. They offered as compensation the same water, upon the same stream, for the same purpose, yet they were obliged to make compensation in money.

MR. RICHARD A. HALE.† Mr. President, I have been very much interested in Mr. Choate's paper, and especially in what he said about twenty-four-hour power. I recall when we were before the New Hampshire legislature asking for a charter for a dam at

* Chief Engineer, Metropolitan Water Works, Boston.
† Principal Assistant Engineer, Essex Company, Lawrence, Mass.

Reed's Ferry, below Manchester, the counsel for the Manchester companies were insistent that a clause should be put into the charter that no interference should be made with the running of the mills above; that they were accustomed to run ten hours a day, and that they should not be obliged to change their running time. They seemed to be a little afraid that if twenty-four-hour power was developed at this point, the upper mills might be asked to send down the water.

There is one point which I think would be of interest, if Mr. Choate could explain something about it, although it does not occur in this state as much as in the state of New York, and that is with regard to the right of the state to take water for the navigation canals which are being built there. A great many suits are being brought by water-power users on the Oswego and other rivers against the state for diversion of water for use in the canals. These parties are located, usually, on state dams, where the state controls the water, and it looks something like a form of blackmail to bring suit against the state for water power which the state has created. These suits have been brought against the state and there appear to be somewhat peculiar ideas in regard to the rights of the state to use the water for the canals, as against the owners of the water powers. Apparently the only rights which they have arise by prescription through a great many years, and whether the state can take the additional water which is required for the large canals without compensation is a question. A case in which the writer testified for the state has recently been heard before the Court of Claims at Albany, and they have awarded a verdict for the mill owners of about eight per cent. of the amount claimed. This award included land taken as well as water power which was claimed to be taken. Much emphasis was placed by the state on the market value of such powers, and what powers had been bought and sold for in recent years, and evidence was admitted on the value of the power, based on knowledge of market values. Evidence of the cost by steam substitution was also presented. The case is to go to the Court of Appeals in order to settle many legal questions relating to the state's rights in navigable streams. Is there any law relating to that subject which can be stated in a few words?

MR. CHOATE. Is this water taken from the Mohawk River?

MR. HALE. I think some water is diverted from the Mohawk, but this case related to the Oswego River at Fulton.

MR. CHOATE. I should suppose that the owner of a privilege, the owner of land on the river, if he owned the land himself and was not simply an occupier of the state's land, would have a right to damages if the water was diverted above him into the canal. Ordinarily one cannot get a right by prescription against the state, and if he had simply settled upon or been permitted to occupy state land, and lost his power because the state had seen fit to use the water for another purpose, I doubt if he could have any remedy at all.

PROGRESS REPORT

OF THE COMMITTEE ON PROPOSED SPECIFICATIONS FOR POST HYDRANTS.

[*Presented January 12, 1910.*]

1. SIZE.

a. The size of hydrants shall be designated by the diameter of the valve opening, which must be at least 5 inches for hydrants having two 2½-inch hose connections and 6 inches for those having three or four 2½-inch hose connections.

In hydrants having valve openings of shapes other than circular, the designation of size must be the diameter of the circle equal in area to that of the valve opening.

b. The net area of the waterway at the smallest part when the hydrant is wide open must not be less than that of the valve opening.

In new designs it is recommended that inside diameter of hydrants be 7 inches and 8 inches respectively for hydrants having 5-inch and 6-inch valve openings.

c. Hydrants must be fitted with bell ends to fit standard pipe, or with flanges of standard dimensions and having standard bolt layouts.

2. GENERAL DESIGN.

a. Any changes in diameter of the water passage through the hydrant must have easy curves and all outlets must have rounded corners of good radius.

b. Hydrants must be so designed that with ordinary usage they will not cause water hammer.

c. Hydrants must be so designed that the leaded joint underground can be strapped.

NOTE. — Further discussion of this report is invited, and may be sent to the Editor

3. MATERIAL OF BODY.

The hydrant body shall be made of cast iron of good quality, such as shall make the metal strong, tough, and of even grain. The strength of the cast iron must be that required by the specifications for cast-iron pipe 12 inches and less in diameter.

4. HOSE NIPPLES AND VALVES.

a. Hose nipples must be of bronze, threaded with a fine thread into the hydrant, and securely pinned in place. Nipples must not be "leaded" into the hydrant.

b. Hose threads on all hydrants to be installed in any given community must of necessity be interchangeable with those already in service, but where practicable threads should conform to the 1906 National Standard adopted by the National Fire Protection Association.

c. Inside hose-gate valves must have bronze working parts and be of rugged design and must not introduce an unnecessary friction loss. There must be ample clearance between the gate and the hydrant body when the gate is in any position. The gate and parts should be interchangeable and the valves should be located so as to be as accessible as possible for repairs. The gate must be designed so that it cannot come off in use. The top of the stem must be below the level of the hydrant stem nut so that the hydrant wrench can be freely operated. If outside hose-gate valves are used instead of inside valves, they must be of bronze or of iron with bronze trimmings, with nipples cast on the valve body and the valve bolted to the hydrant by two $\frac{3}{4}$-inch tap bolts. The valves must not project further than necessary and must be of the inside screw type, placed in a vertical position with the hand-wheel at least 3 inches below the base of the operating nut.

d. The stems of the hose valves must be $\frac{7}{8}$ of an inch in diameter for the $2\frac{1}{2}$-inch valves, and $\frac{7}{8}$ of an inch in diameter for the valves at the steamer connections.

e. The stem nut of the inside hose-gate valve must be $\frac{3}{4}$ of an inch square.

5. HYDRANT SEAT AND GATE.

a. The seat must be made of bronze, securely fastened in place.

b. The valve must be faced with a yielding material such as rubber or leather, and must be designed so that it can be easily removed for repairs without digging up the hydrant.

c. With gate type of valve, clearance of parts must be such that corrosion will not make the parts inoperative.

6. DRIP VALVE.

a. A positively operating non-corrodible drip valve must be provided and arranged so as to completely drain the hydrant when the main valve is shut.

b. The seat on the drip valve must be securely fastened in the barrel. All other parts of the drip mechanism must be designed to be easily removed through the hydrant top.

7. OPERATING STEM.

a. The operating stem at the base of the thread where threaded, and also where it passes through the stuffing box and gland, must be of bronze not less than 1¼ inches in diameter. The bronze must have a tensile strength of not less than 32 000 pounds per square inch. The remainder of the stem may be of iron with cross-sectional area not less than 1½ square inches, except at couplings, where the area may be 1 square inch. The operating stem must be attached so that in operation it will be impossible for it to become detached.

b. The stem must terminate at the top in a nut of pentagonal shape, finished with slight taper to 1½ inches from point to flat, except for hydrants to be installed where existing hydrants have different shape or size of nut, in which case the additional hydrant must have the same operating nut as the old ones for uniformity. The nut socket in the wrench must be made without taper so as to be reversible.

c. The thread which operates the valve must be Acme standard.

8. STUFFING BOX AND GLAND.

a. The stuffing box and gland must be of bronze or bronze-bushed. If a packing nut is used, it must be of bronze. The bottom of the box and end of the gland or packing nut must be slightly beveled.

b. Gland bolts or studs must be at least $\frac{5}{8}$ of an inch in diameter.

c. Gland bolts or studs must be of bronze, iron, or steel. The nuts must always be of bronze.

9. HYDRANT TOP.

a. The hydrant top must be designed so as to make the hydrant as weatherproof as possible and thus overcome the danger of freezing the stem. Provision must be made for oiling both for lubrication and to prevent corrosion. A reasonably tight fit should be made around stems.

b. There must be cast on the hydrant top, in characters raised $\frac{1}{8}$ of an inch, an arrow at least 4 inches long, and the word "Open" in letters 1 inch high.

10. HOSE CAPS.

a. Hose caps must be provided for all hose outlets, and must be securely chained to the barrel with a welded chain of wire not less than $\frac{1}{8}$ of an inch in diameter.

b. The hose-cap nut must be of the same size and shape as the stem nut.

c. A leather washer must be provided in the hose cap, set in a groove to prevent its falling out when the cap is removed.

11. MARKINGS.

Hydrants must be marked with the name or trade mark of the manufacturer, the nominal size, and the year of manufacture. All letters and figures must be cast on the hydrant well above the ground line. They must be 1 inch high and raised $\frac{1}{8}$ of an inch on the casting.

12. TESTING.

a. Hydrants must be tested to at least 300 pounds per square inch before leaving the factory. If the working pressure is over 150 pounds per square inch, the hydrants must be tested to twice the working pressure. The test should be made with the valve open in order to test the whole barrel for porosity and strength of hydrant body. A second test should be made with the valve shut, in order to test the strength and tightness of the valve.

b. Hydrants must be fully opened and closed before shipping

in order to test the freedom and strength of the parts. The conditions of the test should be made as severe as are liable to occur in service when using a hydrant wrench at least 17 inches long.

13. DIRECTION TO OPEN.

Hydrants must open to the left (counter-clockwise), except those to be installed where existing hydrants open to the right, in which case the additional hydrants must turn the same as the old ones for the sake of uniformity.

H. O. LACOUNT, *Chairman*,
GEORGE A. STACY,
FRANK A. McINNES,
FRED W. GOW,
WILLIAM F. SULLIVAN,
Committee.

DISCUSSION.

MR. H. O. LACOUNT.* Mr. President and Members of the Association: In presenting the report of your committee, it will be proper to give a brief account of the work of the committee since it was appointed. On June 11, 1908, the committee sent letters to the seven manufacturers of fire hydrants who were best known to the committee, asking for data regarding the design and construction of their particular hydrants, with the idea of bringing out their respective practices. There were some ten or fifteen particular points covered in the circular. Although seven manufacturers were written to, only three were heard from.

At the January meeting in 1909, we presented a skeleton of the proposed specifications. It was discussed but little, but it showed that progress was being made. At the time of the New York convention in September, 1909, the specifications were sent to the Secretary in a somewhat more complete form, but at the request of the committee they were not presented to the Association because they were not in final form, and because none of the hydrant committee could be present.

* Engineer and Assistant Secretary, Inspection Department, Associated Factory Mutual Insurance Companies, Boston; Chairman Committee to Prepare Standard Specifications for Fire Hydrants.

On October 13, last, the specifications were put in type, substantially as you now have them before you, and copies were sent to manufacturers, to engineers, to sprinkler companies, and, in fact, to every one whom we had any reason to believe would be especially interested in the subject and could help us. We sent out about 40 circular letters, and in answer to those 40 we heard from only 14, and 3 of the 14 stated that they were not hydrant manufacturers and, therefore, were not directly interested and could make no suggestions.

We improved the opportunity to revise the specifications further, based on the returns from the 11 manufacturers, and on information derived from further investigation by the committee. On November 31 a final draft was sent to the same addresses to whom the previous circular had been sent, 42 concerns in all, and of those 42 concerns we heard from but 12, and 9 of those were represented in the letter from Mr. Wood to the Secretary of this Association which was read at the beginning of to-day's meeting,* no suggestions being offered, however, but merely a request to confer with a committee from the manufacturers.

To go back a little, at the New York convention, the suggestion was made that your committee confer with the standing committee on hydrants of the National Fire Protection Association, in order that the action of the two associations might be in harmony. The chairman of your committee, it so happened, was chairman of the other committee, so it was easy to have a joint meeting, so far as the chairmen were concerned.

On December 31, having now something tangible in hand in the form of the proposed specification in type, your chairman sent copies of the proposed specification, to the 14 members of the National Fire Protection Association's committee and 50 per cent. of the members of that committee responded. The seven replies received were generally favorable to the articles as given in the sheets before you.

Such in brief is the history of the work as it has appeared more or less publicly. The committee have also had several meetings, and I wish to make it very clear that our effort from the start has been to emphasize the fact that the committee's office was

* See page 224.

open for business all the time, and that we would welcome suggestions from anybody at any time which would help in the work in hand. Although the hydrant manufacturers have finally held a meeting, for which we are very glad, it was too late to be of any service to the committee at this time. They have had opportunities in the past, and no doubt, in view of your action at the opening of this meeting, they will have further opportunities to assist in working out such details as may not be covered in the pamphlet which you have before you or in the amendments which may be made to it. The work of the committee as it has thus far progressed is in your hands in the type-printed copy, and advance copies to a limited number have been distributed among the members. The request of the committee at this time is that the report should be discussed. We do not expect action to-day, and we certainly do not desire it. The committee, moreover, very earnestly desires to secure the ideas and the experience of the entire membership, especially those of you who have had the opportunity of using fire hydrants, and who know about some of the weaknesses as well as about some of the good points of hydrants as they are made to-day. Presumably the manufacturers, through their committee, will get in their hard work a little later, but we are especially desirous of hearing from the water-works people themselves on the subject. The report is before you, Mr. President and gentlemen, and we await your pleasure as to how you wish to take it up.

THE PRESIDENT. Gentlemen, you have heard Mr. Lacount's report on behalf of the committee, and the chair awaits any discussion with regard to it or any motion. Would Mr. Griswold like to say something?

F. M. GRISWOLD, ESQ.* I should like to say, Mr. Chairman, that it would, in my opinion, be very unwise for any one institution to attempt to set up a standard for so extensive a public utility as a fire hydrant. It is something which should be for the whole United States, and even for our neighbors across the line. The United States idea with relation to fire protection and extinguishment is spreading itself with a good deal of power over into the Canadian provinces and across the line into Mexico, and strenuous effort has been made and much hard work has been done to estab-

* General Inspector, the Home Insurance Company, New York.

lish a standard for hose and hydrant couplings. There is nothing which is more intimately associated with the hose coupling for hydrants and the hose which is hitched on to hydrants than the hydrant itself.

My personal opinion in relation to what should be a hydrant is that a hydrant is simply a device in continuation of your service main, and its outlets are those branches which go to serve a district with so much water for consumption; and my idea of the design of a hydrant is to make a hydrant which will let the water come in and let the water go out with the least loss by friction or obstruction in any way to serve what is the requisite standard. The requisite standard of a fire stream is 250 gallons a minute through a $1\frac{1}{8}$ inch smooth nozzle at the end of 100 feet of hose. Now, if we make as a specification on a broad general statement that a hydrant shall be able to deliver and will deliver at least 80 per cent. of the theoretical discharge of water through a thin disk having an orifice equal to the sum of all the hose outlets, on the formula that the discharge equals the square root of $2gh$, we have got a standard for a hydrant, and that standard for a hydrant is how much water can get in and how much water can get out. We don't care about the particular form of the hydrant or the internal organization of it, but what we want the manufacturers to do is to make a hydrant which will deliver a certain amount of water.

Now under these circumstances, gentlemen, I think it would be a very unwise thing for you to go further at this time than to refer this report back to your committee with power to act in conjunction with the other bodies, — the National Fire Protection Association, the American Water Works Association, and the committee of hydrant manufacturers. If we can get a combination of ideas and a combination of consent among these, it will certainly have a great deal more weight and a great deal more influence than would come from even as illustrious an institution as the New England Water Works Association.

This is something which is absolutely country-wide, and takes in our neighbors as well, and we ought to go ahead with it slowly. It isn't a matter which can be worked out in a day or a week or a month, or perhaps in a year, but certainly if we can get together as I have mentioned, this Association, the National Fire Protection

Association, the American Water Works Association, and a committee chosen by the hydrant manufacturers, we can "cuss" and discuss — and probably cuss more than anything else — this proposed specification as it is now written, and we can reach a conclusion by elimination, and then the majority conclusion will be the controlling conclusion and there will be a national standard hydrant for fire service throughout the whole United States and everywhere where hydrants are used to put out fires on this continent. I hope the only action which will be taken now will be to recommit this report; and if you will carry in your minds the necessity of getting water in and getting water out in the proper quantity, you can have right in that statement an absolute guide for a hydrant. There are certain other details which the manufacturers would be glad to take up with a committee from your Association, composed of men not only with technical skill, but with absolute experience added to it, and the National Fire Protection Association would be glad to take a hand in such a consultation, and the American Water Works Association would also be glad to do so. The hydrant people, as a matter of course, would be forced, if they did not do it voluntarily, to come into such a combination with an intent to establish a standard, and I do not doubt for a moment that we could under an arrangement of that kind reach a satisfactory conclusion, and that the manufacturers would provide a device which would deliver the proper quantity of water and let it go in and let it go out with the least loss. I hope the outcome of your consideration of this matter to-day will be neither a rejection nor a criticism of the report at all, as it is not intended that my remarks shall be, but that the report will be referred back to the committee with the idea that they get together with the other interested parties and make a standard which will meet with general broad-minded approval.

THE PRESIDENT. Will Mr. Wood say something?

MR. WOOD. No; I don't think I care to say anything.

THE PRESIDENT. Mr. Bates?

MR. BATES. I have nothing to say on this subject.

MR. GEORGE A. STACY.* I should say, Mr. President, that the suggestion made by Mr. Griswold to go slow has been fully carried

* Superintendent of Water Works, Marlboro, Mass.

out by this committee. I do not think that he can accuse us of trying to rush this thing to a conclusion. The idea in my mind, when this matter was first broached, was to prevent the deterioration of hydrants as they are manufactured. That is, in the competition that the hydrant makers enter into for securing work there is a natural tendency, and perhaps, a proper one, from their standpoint, to clip a little here and a little there in order to be able to give a little closer figure in the market. The result has been in a number of instances to cheapen and to weaken this very important implement; and to prevent that, and also to protect the manufacturer as well, because our interests are mutual, we desire some standard. I don't think anybody would say that the water-works managers or the Association could go ahead without considering the interests of the manufacturers and do justice to this subject. The only way we can reach a conclusion that will be of any value is by working in harmony and being right-minded in the matter, willing to give a little as well as take a little, and accepting the majority judgment as to what is really best according to practical experience and technical knowledge.

Nobody has thought for a moment of laying down any arbitrary rule, and saying we want just this thing and we don't care whether anybody else does or not. And so I think that this idea of getting together and covering the whole country, as the subject itself covers it, as has been brought out, is a good one. I recognize the fact that if the New England Water Works Association, through its committee, can meet with other interests in this matter and come to a satisfactory conclusion as to the principal elements of what should constitute a standard hydrant, we will reach the object which we have aimed at and will confer a benefit upon ourselves and upon water-works people and the community at large throughout the United States. The subject is as broad as that. We certainly are going slowly in this matter. I heartily endorse our chairman's statement, and I think the whole committee is in accord in seeking information in all quarters, technical and practical, as to what is best to be done. I believe that if we earnestly and honestly work in this matter we can evolve a standard hydrant which will be recognized as the best which can be made; and when a manufacturer goes into the market to figure in competition,

he will go in on a level with every other manufacturer. We have always listened to and sought for the experience of others, their advice and criticism, and that is our attitude here to-day. We welcome this broad-mindedness that asks us to take in the whole country, and the New England Water Works Association is big enough to do it.

MR. WILLIAM F. SULLIVAN.* I want, as a member of the Hydrant Committee, to endorse the remarks of Mr. Stacy. I want to say that the chairman of our committee has worked conscientiously on this matter of hydrant specifications, has given a lot of thought to the subject, and has sought in many directions for information. At our meetings he has stated to us the different ways in which he has endeavored to get opinions and suggestions from hydrant manufacturers.

There are other considerations besides " in and out," referred to by Mr. Griswold, which we took into account when we discussed these proposed specifications. For instance, the question of durability of a hydrant, its appearance and size, the tensile strength of the operating stem, a proper seat and valve and a positive waste. For all these details, which practical water-works men know are essential, we tried to suggest something which would be nearly uniform, and at the same time such as are at present furnished by all the principal makers of hydrants.

The committee expected to hear something from the manufacturers before now, and at every meeting we have held the committee have been open to receive suggestions, advice, and criticisms from the hydrant manufacturers. We waited over a year and no advice has been forthcoming. But I see by their communication received to-day that they are now willing to take some action, and I as one member of the committee am entirely willing to have them do so. I did not intend in any way, shape, or manner to ignore or antagonize the hydrant manufacturers, but at this late day, their letter coming before us in the manner that it did, under the impulse of the moment I moved to lay it on the table. My knowing the amount of time and energy that Mr. Lacount has devoted to this work, I thought it was but right and courteous to him and to the committee to present this report to-

* Engineer and Superintendent, Pennichuck Water Works, Nashua, N. H.

day, believing that after the report was read, the Association could take action upon it, accept or reject it, recommit it or refer the specifications and the letter from the manufacturers to a new committee. As I did not know what manner of sidetracking was intended for the report, I therefore made the motion.

MR. GEORGE H. SNELL.* Mr. President: Personally, I feel that when we talk about standardizing hydrants it is a good deal like a physician prescribing for every patient alike and giving one man the same dose as he would another, without any regard to his constitution or what he requires. That is the way it looks to me. I think there should be a standardization of the nozzles of hydrants, and it seems to me that is about as far as we can conscientiously go. Taking my own town, for instance, the system was installed in 1873, and all hydrants and gates open to the right with a 5-square nut on the hydrant. It would be entirely out of the question for us to change that. That is standardized in itself. We would have to meet those conditions regardless of what the interior of the hydrant might be, or what the make of the hydrant might be. We have several different makes. I am only speaking now of conditions as we find them. We might think of a small town which was going to install a water system, and there might be very little reason to suppose that it would ever grow to any great extent. It ought to be possible for such a town to go into the market and buy a hydrant at a reasonable cost. It seems to me that if we standardize such a thing as a hydrant, each manufacturer has got to make extensive changes in order to conform to it, and that must make it expensive for the consumer. Almost every town has different makes, and it seems to me we should be very careful and consider this matter very thoroughly. I feel that the committee has done a lot of hard work, and if every member of the Association present would express his opinion, I think it would be of great benefit to the committee.

THE PRESIDENT. I will state that this report is simply a report of progress. Notwithstanding the committee was appointed in 1907, this is simply a report of progress, and it ought to be discussed very thoroughly, and I hope it will be at some later meeting. As it is merely a report of progress, of course no action upon it is neces-

* Superintendent Water Works, Attleboro, Mass.

sary. The committee will be continued and no doubt will be glad to hear from the hydrant manufacturers and from the members of the Association too. Would Mr. Gould of the Ludlow Valve Company like to say something?

MR. GOULD. I have nothing to say now, Mr. President.

THE PRESIDENT. If there is any other representative of the hydrant manufacturers here whom I have not called upon, we will be very glad to hear from him now or at another meeting.

MR. CHARLES W. SHERMAN.* If I can remember back correctly to the time when this committee was appointed, I had the honor of making the motion which led to its appointment. My idea, which is evidently the idea which the committee has followed, was that the standardization should be along the same lines as that of the well-known underwriters' fire pump, — not describing in any way the pattern or details, but simply giving the necessary requirements as to quality of materials, workmanship and capacity, and general items of the kind which should be met in any standard hydrant. This would not in any way hinder the manufacturers from continuing to put out their present standard lines, if they wished to do so and could continue to find a market for them.

As we all know, the makers of fire pumps put out their own standard pumps of all kinds besides the underwriter pump, and the underwriter pumps are of different patterns, although they all fulfill the underwriters' specifications.

I haven't had any experience worth mentioning in operating hydrants, but I have had a little experience in buying them, and it was that really which led me to offer the motion. When we go into the market to order hydrants we usually ask for prices from several makers. We get a series of different prices, but those prices are all based on different hydrants. The hydrants differ in various directions, some excel in one part and some in another; and it would certainly be of great advantage to the purchaser to know that the hydrants, although different in pattern, were on a comparable basis, when deciding where to place his order. Too many times orders have been placed merely on the basis of price, and the results have sometimes been unfortunate.

* Principal Assistant Engineer, with Metcalf & Eddy, Consulting Engineers, Boston.

MR. SULLIVAN. About two years ago Mr. Charles L. Newcomb read a paper on fire hydrants * before this Association. In it he showed conclusively that there was a great difference in the efficiency of different makes of hydrants. During the discussion at that meeting, I asked what was a standard 6-inch hydrant. The reason I asked the question was because in my company we have a contract with the city which specifies a standard 6-inch hydrant. No one could tell me at that time what a 6-inch hydrant was, and I do not believe my question can be answered correctly now. Mr. Stacy and others supplemented my remarks, and the result was that this hydrant committee was appointed. When one says a 6-inch hydrant, he may mean a hydrant with a 6-inch valve opening or with a 6-inch barrel or with a 6-inch inlet or with any of these dimensions in combination with any others. The fire commissioners of our city who pass upon hydrant installations look at the size of the barrel. They see it is all right, but they do not know what is down below. It may be a 4-inch valve opening or a 4-inch inlet. I hope this whole subject will appeal to the members and that they will all take an interest in it and help us to get up something which we can all tie to.

MR. SHERMAN. It seems to me that the Association should not delay too long the adoption of specifications if other organizations and the manufacturers cannot be brought into line without great delay. It is not a difficult matter to modify or amend specifications even after they have been adopted as a standard, and as we have seen by the letter presented to-day, the possibility of the adoption of such a standard at this meeting has stirred the manufacturers to action, at least to the extent of organizing and appointing a committee upon this matter. I believe in all probability that they will now confer with our committee and that we may expect to get suggestions from them; and I think through the chairman of our committee, who also represents the National Fire Protection Association, and conferences with hydrant makers and other people interested in the subject all over the country, we shall have a broad enough discussion so that we need not hesitate to pass — for the time being, at least — upon specifications when the committee feels ready to present a final report.

* Vol. XXI, No. 4, p. 378.

MR. GRISWOLD. May I say one word along that same line. The idea I tried to give you was in the line of expedition. It seems to me that the quickest way to dispose of this matter is to have a committee from each of the interested organizations, not to write letters, but to meet personally and discuss and eliminate differences of opinion and arrive at a conclusion. My idea of expedition would be that the chairman of the committee should call, or practically demand that a representative or representatives, from each of the other organizations should meet his committee and discuss and eliminate the differences and make a standard which would hold water.

MR. STACY. I don't know how anybody could have got the idea that the committee wants to determine what shall be the style or the shape of the outside of a hydrant. We don't care to dictate about the general appearance of a hydrant; we are willing to leave that wholly to the artistic ideas of the manufacturers; but we do consider that there are certain essential elements in a hydrant which should be standardized, and that is what we want to arrive at. We are willing to leave to the manufacturers how the hydrant shall look when it is set in the ground.

MR. M. F. COLLINS.* I should like to ask if this committee has full power at the present time to meet a committee of the manufacturers for the purpose of discussing this matter.

THE PRESIDENT. I think there was a vote passed to that effect.

MR. SHERMAN. I don't know about the vote, but it was certainly the intention that the committee should have that power.

THE PRESIDENT. Can the Secretary inform Mr. Collins as to whether there was a vote passed giving this committee power to confer with other organizations? I know authority was given them to confer with National Fire Protection Association.

MR. KENT. I think there was such a vote, although it was not incorporated in the original vote for the appointment of the committee.

MR. CHASE. May I ask, Mr. President, if the discussion on this question is to be closed now, or will the matter come up at the

* Superintendent of Water Works, Lawrence, Mass.

next meeting? It seems to me that the committee has done a great deal of work and it is entitled to the benefit of a full discussion of its report.

THE PRESIDENT. The matter will come up again, certainly, because the report of the committee is only a report of progress, and there will have to be a further report.

PROCEEDINGS.

December Meeting.

Hotel Brunswick,
Boston, December 8, 1909.

President Robert J. Thomas in the chair.

The following members and guests were present:

Members.

S. A. Agnew, L. M. Bancroft, F. A. Barbour, H. K. Barrows, G. W. Batchelder, F. D. Barry, J. F. Bigelow, A. E. Blackmer, Dexter Brackett, E. C Brooks, J. C. Chase, J. H. Child, C. E. Childs, H. W. Clark, M. F. Collins, G. K. Crandall, J. W. Crawford, G. E. Crowell, G. W. Cutting, Jr., E. D. Eldridge, J. A. Fitch, J. H. Flynn, A. S. Glover, E. L. Grimes, F. H. Gunther, R. A. Hale, R. K. Hale, F. E. Hall, J. O. Hall, E. A. W. Hammatt, J. C. Hammond, Jr., L. M. Hastings, T. G. Hazard, Jr., D. A. Heffernan, M. F. Hicks, J. L. Howard, F. M. Hutchinson, W. S. Johnson, E. W. Kent, Willard Kent, G. A. King, E. A. McMillen, C. T. Main, D. E. Makepeace, John Mayo, F. E. Merrill, G. F. Merrill, Leonard Metcalf, H. A. Miller, William Naylor, E. M. Peck, W. A. Peirce, H. E. Perry, Dwight Porter, Henry Roberts, Ransom Rowe, H. W. Sanderson, E. M. Shedd, C. W. Sherman, G. H. Snell, G. A. Stacy, G. T. Staples, J. T. Stevens, Wm. F. Sullivan, L. A. Taylor, H. L. Thomas, R. J. Thomas, W. H. Thomas, J. L. Tighe, W. H. Vaughn, C. K. Walker, F. B. Wilkins, C. E. Winslow. — 73.

Associates.

Allen & Reed, by Z. M. Jenks; Anderson Coupling Company, by Charles E. Pratt; Harold L. Bond & Co., by F. M. Bates; Builders Iron Foundry Company, by A. B. Coulters; Darling Pump and Manufacturing Company (Limited), by H. H. Davis; Eagle Oil and Supply Company, by John L. Hamilton; George E. Gilchrist Company, by E. H. Ellis, Jr.; Hersey Manufacturing Company, by Albert S. Glover; International Steam Pump Company, by Samuel Harrison; Lead Lined Iron Pipe Company, by T. E. Dwyer; Charles Millar & Sons Company, by C. F. Glavin; H. Mueller Manufacturing Company, by G. A. Caldwell; National Meter Company, by J. G. Lufkin; Neptune Meter Company, by H. H. Kinsey and F. A. Smith; Pitometer Company, by J. F. Flaherty; Rensselaer Manufacturing Company, by F. S. Bates and C. L. Brown; Ross Valve Manufacturing Company, by William Ross; A. P. Smith Manufacturing Company, by Fred N. Whitcomb; Union

Water Meter Company, by Frank E. Hall; United States Cast Iron Pipe and Foundry Company, by F. W. Nevins. — 22.

GUESTS.

Messrs. Charles F. Choate, Jr., Arthur P. Stone, F. M. Copeland, Robert S. Dodge, Charles F. Merrill, J. H. Hallowell, James Campbell, Ralph A. Stewart, Boston Mass.; Ernest Johnson, New York City; H. R. Burbeck and C. L. Baker, Abington, Mass.; Samuel F. Compton, East Greenwich, R. I.; J. F. Strub, Marlboro, Mass.; and Mr. Dutcher, Hopedale, Mass. — 14.

Applications for active membership, approved by the Executive Committee, were received from J. Rosenan, Brookline, Mass., and Elliot R. B. Allardice, superintendent of the Wachusett Department of the Metropolitan Water Works. On motion of Mr. Bancroft, the Secretary was directed to cast the ballot of the Association in favor of the applicants, and he having done so they were declared elected members.

Charles F. Choate, Jr., Esq., of Boston, Mass., spoke on "The Underlying Principles Governing Riparian Water Rights and Diversion Suits." Leonard Metcalf, Charles W. Sherman, Dexter Brackett, and Richard A. Hale participated in the discussion which followed. On motion of Dexter Brackett, a vote of thanks was tendered Mr. Choate for his "very instructive and interesting address."

Mr. Leonard Metcalf, Boston, Mass., presented a report of the committee "to collect data relating to awards that have been made for damages resulting from the diversion of water; also to consider the practicability of joint action with the National Cotton Manufacturers Association or other organizations of mill owners leading to the formulation of standard rules and methods of computing or assessing damages for the diversion of water." Messrs. Harold K. Barrows, Richard A. Hale, E. L. Grimes, and Jasper F. Fitch spoke upon matters developed in the report.

Mr. Frank A. Barbour, Boston, Mass., reported for the committee "to gather statistics relating to the depth at which water pipes are laid and the resulting experience with frozen pipes." The discussion which followed was participated in by Messrs. Leonard Metcalf, R. C. P. Coggeshall, George A. Stacy, Charles W. Sherman, and John H. Flynn.

Adjourned.

Annual Meeting.

Hotel Brunswick,
Boston, January 12, 1910.

The President, Mr. Robert J. Thomas, in the chair.
The following members and guests were present:

Members.

S. A. Agnew, L. M. Bancroft, Roland Barnes, G. W. Batchelder, F. D. Berry, J. F. Bigelow, A. E. Blackmer, J. W. Blackmer, Dexter Brackett, E. C. Brooks, G. A. P. Bucknam, James Burnie, J. C. Chase, R. D. Chase, R. C. P. Coggeshall, M. F. Collins, W. R. Conard, B. I. Cook, H. R. Cooper, J. W. Crawford, John Doyle, E. R. Dyer, E. D. Eldredge, B. R. Felton, C. R. Felton, J. N. Ferguson, J. H. Flynn, F. F. Forbes, F. L. Fuller, C. W. Gilbert, J. C. Gilbert, A. S. Glover, F. H. Gunther, R. A. Hale, R. K. Hale, F. C. Hersey, Jr., M. F. Hicks, H. G. Holden, J. L. Howard, F. M. Hutchinson, W. S. Johnson, E. W. Kent, Willard Kent, F. C. Kimball, G. A King, J. J. Kirkpatrick, H. O. Lacount, E. S. Larned, E. E. Lochridge, A. R. McCallum, F. A. McInnes, N. A. McMillen, D. E. Makepeace, A. E. Martin, W. P. Mason, John Mayo, A. S. Merrill, F. E. Merrill, H. A. Miller, William Naylor, A. S. Negus, R. R. Newman, F. L. Northrop, E. M. Peck, Dwight Porter, W. H. Richards, Henry Roberts, H. E. Royce, G. A. Sanborn, W. H. Sears, E. M. Shedd, J. E. Sheldon, C. W. Sherman G. H. Snell, G. A. Stacy, C. A. Stone, W. F. Sullivan, G. F. Swain, L. A. Taylor, H. L. Thomas, R. J. Thomas, W. L. Thomas, L. D. Thorpe, J. L. Tighe, D. N. Tower, C. H. Tuttle, W. H. Vaughn, C. K. Walker, J. H. Walsh, R. S. Weston, J. C. Whitney, C. E. Winslow, H. B. Wood, I. S. Wood. — 93.

Associates.

Anderson Coupling Company, by Charles E. Pratt; Ashton Valve Company, by C. W. Houghton; Builders Iron Foundry Company, by A. B. Coulters and F. N. Connet; Chapman Valve Manufacturing Company, by H. L. DeWolf; Darling Pump and Manufacturing Company (Limited), by J. L. Hough and H. H. Davis; F. H. Hayes Machinery Company, by F. H. Hayes; Hersey Manufacturing Company, by Albert S. Glover; International Steam Pump Company, by Samuel Harrison; Lead Lined Iron Pipe Company, by T. E. Dwyer; Ludlow Valve Manufacturing Company, by H. F. Gould; Charles Millar & Son Company, by Charles F. Glavin; H. Mueller Manufacturing Company, by G. A. Caldwell; National Meter Company, by C. H. Baldwin, J. G. Lufkin, and H. L. Weston; Neptune Meter Company, by H. H. Kinsey; Pitometer Company, by James F. Flaherty; Pittsburg Meter Company, by F. L. Northrop; Rensselaer Manufacturing Company, by F. S. Bates and C. L. Brown; Ross Valve Manufacturing Company, by William Ross; A. P. Smith Manufacturing Company, by F. N. Whitcomb; Thomson Meter Com-

pany, by S. D. Higley and E. M. Shedd; Union Water Meter Company, by F. E. Hall and Edw. F. King; United States Cast Iron Pipe and Foundry Company, by Frank W. Nevins; Waldo Brothers, by H. E. Browne; Water Works Equipment Company, by W. H. Van Winkle; R. D. Wood & Co., by Walter Wood and Wm. F. Woodburn. — 33.

GUESTS.

John J. Sullivan, Lowell, Mass.; Frank Whitlock, Fostoria, Ohio; F. M. Griswold, New York City; A. C. Lamson, Marlboro, Mass.; E. R. B. Allardice, Clinton, Mass.; J. J. Moore, G. H. Perry, W. O. Teague, R. L. Cary, Edward F. Hughes, Prof. D. C. Jackson, Howard S. Richards, Boston, Mass.; John F. Gleason, Quincy, Mass.; and R. P. M. Lewis, of *Fire and Water Engineering*, New York City. — 14.

The following were elected members of the Association, having been duly approved by the Executive Committee, and one ballot cast for them by the Secretary, in accordance with the vote of the Association on motion of Mr. Frank L. Fuller:

Active. — Lewis R. Dunn, Winthrop, Mass., superintendent Winthrop Water Department; G. A. Sampson, assistant engineer with William Wheeler, Boston, Mass.; Watson Van Winkle, Seattle, Wash., assistant chemist, United States Geological Survey, in charge of investigation of quality and economic value of California waters, and also in charge of investigation of quality of Columbia River waters.

Associate. — Julian d'Este Company, Boston, manufacturer of engineering specialties, pressure regulators for water, steam, etc.

The President read the following letter:

TROY, N. Y., January 10, 1910.

MR. WILLARD KENT, *Secretary*,
New England Water Works Association,
Tremont Temple, Boston, Mass.:

Dear Sir, — The meeting of manufacturers of hydrants, held at the Rensselaer Inn, Troy, N. Y., January 10, 1910, after discussing the specifications on hydrants forwarded to them by your committee, request that a committee of your body be appointed to meet a committee of the hydrant manufacturers to perfect the minor details of construction which such specifications require in order to be complete and full in all its details.

Yours truly,
(Signed) WALTER WOOD, *President*.
JAS. H. CALDWELL, *Secretary*.

There were represented at the meeting: R. D. Wood & Co., Chapman Valve Manufacturing Company, Roe Stephens Valve Manufacturing Company, Darling Pump and Valve Manufacturing Company, Norwood Engineering Company, Eddy Valve Company, Rensselaer Manufacturing Company, The Ludlow Valve Manufacturing Company, Kennedy Valve Manufacturing Company.

Mr. George H. Snell moved that the communication be received and the request complied with. The President suggested that the letter be referred to the Committee on Hydrants, and Mr. Snell then made that motion. Mr. William F. Sullivan thought it would be well to lay the matter on the table until after the report of the Committee on Hydrants had been received, as after the committee had reported it might possibly "go out of business" and some other committee be appointed. Upon the assurance of the President that the present committee would undoubtedly be continued, Mr. Sullivan withdrew his motion to lay on the table. Mr. Snell's motion to refer the matter to the Hydrant Committee was adopted.

A communication was received from Mr. J. P. Beck, general manager of the Cement Products Exhibition Company, calling attention to the Third Annual Cement Show to be held in Chicago, February 18–26, 1910.

Messrs. Richard A. Hale and Lewis M. Bancroft, being a committee appointed by the President, submitted a memorial on Mr. Earle Harvey Gowing, who died November 24, 1909. On motion of Mr. Sherman, it was voted that the memorial be received, placed on record, and published in the Proceedings of the Association.

The retiring President, Mr. Robert J. Thomas, then delivered the following address:

Address of the Retiring President.

Gentlemen, — The New England Water Works Association has added to its history another year of achievement through the labor of its committees, officers and members, in the advancement and exchange of knowledge pertaining to the construction and management of water works. The work of the past year differs but slightly from other years.

In point of membership, a net gain of 19 members during the year is gratifying compared with a small loss the previous year.

Yet in view of the vast number of water-works systems unrepresented in the Association, it obvious that there is still a large field for the expansion of our membership. While it gives us pleasure to note that our society has now reached a total net membership of 715 in good standing, it is to be regretted that 25 members had to be dropped for non-payment of dues and that 12 others saw fit to resign; that is, however, their loss.

The "grim reaper," Death, has been very busy amongst our membership during the year, with the result that eight active and one honorary member have gone from us forever. May the recollection of their good deeds be an inspiration to us. Two of these departed members favored the society with papers during the year. Following the custom I will read the names of the deceased members: J. E. Beals, G. H. Bishop, F. A. W. Davis, I. C. Forbes, E. H. Gowing, A. A. Knudson, C. F. Story, L. F. Rice, and Edwin Reynolds.

Financially, the organization is about in the same sound condition that it was left at the close of last year.

The papers and reports presented at the different meetings during the year cover a wide variety of subjects. At the February meeting, the late Mr. A. A. Knudson read a paper on "Lead-Covered Cables, a Cause of Electrolysis upon Water and Gas Pipe." This paper suggested a new cause of trouble, another source of electrolytic action to be guarded against.

The paper of ex-President Merrill on the "Grounding Electric Light Wires on Water Pipes," also read at this meeting, brought up an important matter for consideration. Officers of the Edison Electric Light Company who were guests of Mr. Merrill discussed the paper from the Electric Company's standpoint. From the water-works side of the question very little was said, probably because the matter is still new and not fully developed.

The Hon. Joseph C. Pelletier, of the Massachusetts Civil Service Commission, addressed the March meeting on the "Civil Service in Its Application to the Water Department." At the same meeting a very valuable and interesting paper on "The Ludlow Filters" was read by the late Carroll F. Story.

At the annual meeting in New York the following papers were presented:

"The Development of the Camaguey (Cuba) Water Works," by Henry A. Young, C. E.; "The Poughkeepsie Water Works," by Dr. John C. Otis; "Disinfection as an Adjunct to Water Purification," by H. W. Clark and Stephen DeM. Gage; "Odors and Tastes in the Water Supply of Holyoke," by James L. Tighe, city engineer, Holyoke, Mass.; "New York City Water Supply," by William W. Brush, C. E.

At the November meeting, Mr. W. S. Johnson gave the meeting a highly interesting treatise on "Ground Waters as Sources of Public Water Supplies."

At the December meeting, Mr. Charles F. Choate, Jr., delivered a most remarkably able and instructive address on "The Underlying Principles Governing Riparian Water Rights and Diversion Suits." This address was followed by the report of the Committee on Water Diversion, etc., an exhaustive and comprehensive statement of facts and figures bearing on the settlement of water damage suits. This report as represented by Mr. Leonard Metcalf, together with the discussion on it, and Mr. Choate's valuable address, will probably make that number of the JOURNAL in which they appear the most valuable we have ever had. Mr. F. A. Barbour also reported at this meeting in behalf of the committee to compile statistics relating to the proper depth at which mains should be laid to prevent freezing. This report was unique inasmuch as it was probably the first attempt to gather and systematize information on this very important branch of water works.

A new committee, headed by Mr. Charles W. Sherman, was appointed to ascertain the custom followed by towns regarding extraordinary extension of mains.

All of the Boston meetings were successful both in attendance and in the program offered. The June meeting was all that could be desired excepting in the essential of attendance. The 121 members and guests who were present, however, had an enjoyable trip on a most delightful day.

At the June meeting the Executive Committee unanimously declined the proposal from the Water Works Manufacturers' Association that they furnish entertainment at our Annual Convention, they to have the control of the distribution of badges and the management of the exhibits. It is feared that our friends in

the supply business who comprise the Water Works Manufacturers' Association did not take very kindly to this action of the Executive Committee, yet they can rest assured that the committee was not actuated by any prejudice towards them, but rather they were animated by the feeling that when their fellow members in the associate class supplied their needs by up-to-date tools, appliances, material, and other supplies of good quality promptly and at a reasonable and fair price that is all they had a right to expect.

The annual meeting, held at the Park Avenue Hotel, New York City, September 8, 9, and 10, was an unqualified success. In point of attendance we have had probably greater numbers at some of our past meetings, but at very few has the number of active members present been surpassed.

Mr. George Batchelder, chairman of the General Committee, and Mr. George Rice, chairman of the Local Committee of Arrangements, and his colleagues, deserve the thanks of the Association for their work, including the entertainment provided at the reception on Tuesday evening, and also on the trip to Ashokan Reservoir, on Friday. This latter event, although during the day on which it took place it rained continuously, I venture to say was most thoroughly enjoyed by those attending, and, despite the rain, there was very little real discomfort. The singing by the engineering staff at the reservoir struck a responsive chord, especially the chorus, "Hold the Dam Waldo, for we are coming." Mr. Fred Whitcomb, who had charge of the exhibits, deserved credit for the successful manner in which he handled that important and instructive feature of the annual meeting.

In order to get a general idea of what a retiring president was expected to talk about in his annual address, I naturally consulted the files of the JOURNAL to see what my predecessors had to say. I found their addresses good reading and contained, as I supposed they would, a review of the work of the Society for the years during which they presided. In addition, I discovered wise recommendations made to the Association; one in particular which struck me very forcibly was repeatedly mentioned: that was the advisability of more general discussion at the meetings, this to be brought about by having copies of all papers sent out in advance to the

members so that those not able to be present at the meeting could send their views in writing. This plan would also allow the reading of many of the papers by their title, thus saving time for topical discussion, which many of the past presidents thought ought to be encouraged. No doubt these recommendations when made were inspired by the hope that the Association would be bettered by their adoption. Certainly they looked for some action in regard to them. When we stop to consider, moreover, that at least some of those past presidents were men whose opinion is entitled to weight, it must seem strange that nothing has come of their suggestions. The advice of one at least of these past presidents is generally considered valuable, and sometimes commands a high price. With the risk of having my humble recommendation also overlooked, I most sincerely urge upon the Association the appointment of a committee of five to consider and report upon the recommendations and suggestions in the annual addresses of our retiring presidents.

Speaking of committees, I wonder if the Association appreciates fully the vast amount of labor and time that some of the committees put into their reports, and how much we are indebted to those members. In saying this, I have in mind the Committee on Water Diversion Matters; and the Committee on the Depth at which Water Mains should be Laid, which reported at the last meeting; also the Committee on Hydrant Specifications, although they have not reported as yet finally. From their preliminary reports we are enabled to judge of the painstaking character of their work.

It gives one pleasure to be able to state that the officers of the Association, from the President down, have performed their duties faithfully and to the best of their ability. I wish to specially commend Miss Ham, the assistant secretary, for the prompt, efficient service rendered by her.

The Executive Committee meetings have been well attended, and the business of the Association has received careful and conscientious consideration at the hands of this committee.

The mayor of Rochester, N. Y., and the president of the Board of Trade sent an invitation to the Association at the annual meeting in New York to have their next meeting at Rochester. It was received too late to come before the New York meeting,

Year.	President.	Membership at End of Year.				Annual Convention.		Receipts.	Expenditures.	Cash Balance.
		Members.	Associate.	Honorary.	Total.	Place.	Date.			
1882	(Organized)	27	—	—	27	Boston, Mass.	June 21, '82			
1882–3	*James W. Lyon	37	6	—	43	Worcester, Mass.	June 21, '83	$245.00	$87.86	$157.14
1883–4	Frank E. Hall	48	9	—	57	Lowell, Mass.	June 19–20, '84	156.14	171.90	141.38
1884–5	*George A. Ellis	83	44	—	127	Springfield, Mass.	June 18–19, '85	651.84	511.44	281.78
1885–6	R. C. P. Coggeshall	106	47	—	153	New Bedford, Mass.	June 16–18, '86	1 658.50	1 643.42	296.86
1886–7	*Henry W. Rogers	137	52	2	191	Manchester, N. H.	June 15–17, '87	1 342.28	1 066.98	572.16
1887–8	*Edwin Darling	181	54	3	238	Providence, R. I.	June 13–15, '88	2 013.30	1 697.15	888.31
1888–9	*Hiram Nevons	209	64	4	277	Fall River, Mass.	June 12–14, '89	2 204.07	2 127.70	964.68
1889–90	Dexter Brackett	257	73	5	335	Portland, Me.	June 11–13, '90	2 511.27	2 346.65	1 129.30
1890–1	*Albert F. Noyes	281	74	5	360	Hartford, Conn.	June 10–12, '91	3 055.13	1 884.78	2 299.65
1891–2	Horace G. Holden	290	70	5	365	Holyoke, Mass.	June 8–10, '92	2 887.17	3 278.54	1 908.28
1892–3	George F. Chace	338	69	5	412	Worcester, Mass.	June 14–16, '93	3 422.61	3 317.22	2 013.67
1893–4	*Geo. E. Batchelder	365	73	5	443	Boston, Mass.	June 14–16, '94	3 208.85	3 259.07	1 963.45
1894–5	George A. Stacy	401	81	5	487	Burlington, Vt.	Sept. 11–13, '95	3 147.41	3 115.99	2 673.03
1895–6	Desmond FitzGerald	442	82	5	529	Lynn, Mass.	June 10–12, '96	3 179.91	3 148.49	2 704.45
1896–7	*John C. Haskell	464	80	5	549	Newport, R. I.	Sept. 8–10, '97	3 340.23	3 322.94	2 721.74
1897–8	Willard Kent	488	77	5	570	Portsmouth, N. H.	Sept. 14–16, '98	3 002.13	2 786.95	2 936.92
1898–9	Fayette F. Forbes	494	73	5	572	Syracuse, N. Y.	Sept. 13–15, '99	2 825.71	3 050.23	2 712.40
1899–1900	Byron I. Cook	519	70	5	594	Rutland, Vt.	Sept. 19–20, '00	4 920.49	5 524.65	2 108.24
1901	Frank H. Crandall	493	58	4	555	Portland, Me.	Sept. 18–20, '01	4 238.55	4 283.22	2 063.57
1902	Frank E. Merrill	522	60	5	587	Boston, Mass.	Sept. 10–12, '02	5 158.48	4 680.32	2 541.73
1903	Charles K. Walker	520	55	3	586	Montreal, Canada	Sept. 9–11, '03	5 032.40	4 505.08	3 069.05
1904	Edwin C. Brooks	538	58	8	604	Holyoke, Mass.	Sept. 14–16, '04	5 328.31	5 528.21	2 869.15
1905	George Bowers	584	53	8	645	New York, N. Y.	Sept. 13–16, '05	5 431.16	5 411.58	2 888.73
1906	Wm. T. Sedgwick	618	51	15	684	White Mts., N. H.	Sept. 12–14, '06	5 366.94	4 845.14	3 410.53
1907	John C. Whitney	636	51	15	702	Springfield, Mass.	Sept. 11–13, '07	5 291.83	†4 222.06	4 480.30
1908	Alfred E. Martin	633	49	14	696	Atlantic City, N. J.	Sept. 23–25, '08	5 706.36	7 475.56	‡2 711.10
1909	Robert J. Thomas	647	55	13	715	New York, N. Y.	Sept. 8–10, '09	5 303.31	†4 566.84	‡3 449.57

*Deceased.

† Not including December JOURNAL and reprints.

‡ Does not include $1 815 invested in bonds.

but is now in the hands of the Executive Committee, who have full power in the selection of the place for the next annual meeting.

Gentlemen, in closing, I assure you that I am deeply sensible of the courtesy and kindness you have all manifested towards me during my year as President.

The Secretary, Mr. Willard Kent, submitted the following report:

Report of the Secretary.

Mr. President and Members of the New England Water Works Association, — Your Secretary submits the following report of membership, money received, and disbursements approved on account of the New England Water Works Association for the year ending December 31, 1909:

MEMBERSHIP.

The present membership of the Association is 715; that of one year ago was 696, a gain of 19 during the year.

The detailed statement of the changes in membership during the past year in the several grades is as follows:

MEMBERS.

January 1, 1909.	Total members		633	
	Withdrawals:			
	Resigned	12		
	Died	8		
	Dropped	25	45	588
	Initiations:			
	January	6		
	February	5		
	March	7		
	June	5		
	September	9		
	November	6		
	December	1	39	
	Two members elected in 1908, but qualified in 1909		2	41

	Reinstated:			
	Member dropped in 1906		1	
	Members dropped in 1908		5	
	Members dropped in 1909		10	
	Member resigned in 1908		1	
	Member resigned in 1909		1	18
				647

HONORARY MEMBERS.

January 1, 1909.	Honorary members		14	
	Died		1	13

ASSOCIATES.

January 1, 1909.	Total associates		49	
	Withdrawals:			
	Resigned	2		
	Dropped	1	3	46
	Initiations:			
	January	1		
	March	1		
	June	1		
	September	5	8	
	Reinstated:			
	Member dropped in 1909		1	55
January 1, 1910.	Total membership			715

SUMMARY OF RECEIPTS AND DISBURSEMENTS OF THE NEW ENGLAND WATER WORKS ASSOCIATION FOR THE YEAR 1909.

RECEIPTS.

Initiation fees			$238.00
Annual dues:			
Members	$1 950.00		
Associates	750.00	$2 700.00	
Fractional dues:			
Members	$24.00		
Associates	32.50	56.50	
Past dues		29.00	2 785.50
Advertisements			1 620.00
Subscriptions			189.00
JOURNALS sold			68.25
Sundries			90.55
June excursion			113.00
Total receipts			$5 104.30

DISBURSEMENTS.

JOURNAL	$1 328.63
Stationery and printing	713.95
Assistant Secretary	600.00
Incidental expenses	328.86
Rent	300.00
Editor	225.00
Secretary	200.00
Advertising agent	171.50
June excursion	150.00
Stenographer	138.75
Reprints	99.35
Music	75.00
Stereopticon	67.70
Treasurer	50.00
Badges	50.00
Library	12.75
Insurance	15.00
Total disbursements	$4 526.49

At present there is due the Association:	
For advertisements	$95.00
For Standard Specifications	.10
For index	1.00
For reprints	21.57
Total	$117.67
At present there are outstanding bills against the Association as follows:	
Printing, about	$1 000.00
Stenographer	52.50
Rent	100.00
Advertising agent	63.00
Total, about	$1 215.50

The Treasurer, Mr. Lewis M. Bancroft, submitted the following report:

LEWIS M. BANCROFT, TREASURER.

In account with the New England Water Works Association.

RECEIPTS.			EXPENDITURES.	
1909.				
Jan. 6	Balance on hand	$2 711.10	Paid bills, as per itemized statement	$4 566.84
Aug. 1	Dividend, People's Savings Bank, Worcester	67.22	BALANCE ON HAND.	
Nov. 1	Coupons, L. S. & Mich. So. R. R. bonds	80.00	Deposit, People's Savings Bank, Worcester	1 731.86
Dec. 1	Dividend, Mechanics Savings Bank, Reading	35.30	,, Mechanics Savings Bank, Reading	1 035 30
	Interest on deposits	18.49	,, First National Bank, Reading	45.38
Feb. 10	Rec'd of Willard Kent, Sec'y, $1 771.00		,, Liberty Trust Co., Boston	637.03
March 9	,, ,, ,, ,, ,, 805.30			
May 15	,, ,, ,, ,, ,, 789.70			
July 1	,, ,, ,, ,, ,, 113.00			
,, 21	,, ,, ,, ,, ,, 359.00			
Nov. 5	,, ,, ,, ,, ,, 621.95			
1910.				
Jan. 3	,, ,, ,, ,, ,, 644 35	5 104.30		
		$8 016.41		$8 016.41

ASSETS AND LIABILITIES.

ASSETS.		LIABILITIES.	
Cash balance in banks	$3 449.57	Bill due for Library search	$3.20
Bonds Nos. 2642 and 2644, Lake Shore & Mich. So. R. R., 4%, due May 1, 1931. Book value, $1 815.00. Market value	1 900.00	Net assets	5 346.37
	$5 349.57		$5 349.57

Approved as correct, January 7, 1910.

GEORGE CASSELL,
JOHN C. CHASE, } *Auditing Committee.*

READING, MASS., January 6, 1910.

LEWIS M. BANCROFT, *Treasurer.*

DETAILED STATEMENT OF BILLS PAID.

1909.		
February 10	Robert J. Thomas, advertising agent to January 1, 1909	$62.00
	L. M. Bancroft & Son, bond	15.00
	Thomas P. Taylor, stereopticon	10.00
	American Society of Civil Engineers, binding	4.00
	Miss J. M. Ham, salary for January	50.00
	W. N. Hughes, envelopes and printing	65.00
	The Brunswick, music, January meeting	15.00
	D. Gillies' Sons, printing	63.98
March 11	The Brunswick, music, February meeting	15.00
	W. N. Hughes, binding and printing	32.50
	Miss J. M. Ham, salary for February	50.00
	Remington Typewriter Company, overhauling machine	16.74
	D. Gillies' Sons, printing	4.50
	Boston Society of Civil Engineers, rent to February 28	100.00
27	Miss J. M. Ham, salary for March	50.00
April 1	W. N. Hughes, printing	3.75
	Thomas P. Taylor, stereopticon	20.00
	Hub Engraving Company, plates	24.90
	The Brunswick, music, March meeting	15.00
	Willard Kent, salary to March 31	50.00
	Willard Kent, expenses to March 31	58.85
10	Charles W. Sherman, advertising agent to April 1	58.75
	Bacon & Burpee, report of January, February, and March meetings	58.75
	Richard K. Hale, salary to April 1	75.00
	Richard K. Hale, postage and expenses	9.60
May 1	American Society of Civil Engineers, library search	18.45
	Miss J. M. Ham, salary for April	50.00
19	Samuel Usher, printing March JOURNAL and reprints	455.72
	Hub Engraving Company, plates	4.89
	Suffolk Engraving and Electrotyping Company, plates	5.47
28	W. N. Hughes, printing	3.00
	The Mudge Press, printing	5.50
	Miss J. M. Ham, salary for May	50.00
June 15	D. Gillies' Sons, printing	5.75
	Boston Society of Civil Engineers, rent to May 31	100.00
30	Henry A. Wheeler & Co., burgee	10.00
	Amount carried forward	$1 637.10

	Amount brought forward	$1 637.10
June 30	W. N. Hughes, printing	2.00
	Steamer *King Philip*, June meeting	150.00
	Miss J. M. Ham, salary for June	50.00
July 8	Samuel Usher, printing	173.00
17	Willard Kent, salary to July 1	50.00
	Willard Kent, expenses to July 1	10.00
	Charles W. Sherman, advertising agent	57.50
23	Miss J. M. Ham, salary for July	50.00
	Miss J. M. Ham, expenses	45.37
	Richard K. Hale, salary to July 1	75.00
	Richard K. Hale, expenses	11.00
27	Geo. W. Batchelder, expenses annual convention	19.70
August 12	Samuel Usher, Standard Specifications	27.50
	Suffolk Engraving Company, plates	7.87
	Wm. E. Whittaker, drafting	1.00
September 6	W. N. Hughes, envelopes and printing	48.00
	D. Gillies' Sons, printing	10.50
	Miss J. M. Ham, salary for August	50.00
13	W. N. Hughes, printing	15.50
	Boston Badge Company, badges	50.00
	Samuel Usher, June JOURNAL and reprints	335.50
16	Fred P. Chase, wreath, Jos. E. Beals' funeral	10.00
20	Thomas P. Taylor, stereopticon, N. Y. convention,	37.70
October 18	Suffolk Engraving and Electrotyping Company, plates	2.24
	Miss J. M. Ham, salary for September	50.00
	Willard Kent, salary to October 1	50.00
	Willard Kent, expenses	10.00
November 6	Boston Society of Civil Engineers, rent to August 31,	100.00
	Bacon & Burpee, report of twenty-eighth annual convention	80.00
	Samuel Usher, printing	35.00
	Miss J. M. Ham, salary for October	50.00
	Miss J. M. Ham, expenses	81.54
	Wm. E. Whittaker, making drawing	3.50
	W. N. Hughes, printing	33.75
25	D. Gillies' Sons, printing	38.75
	The Brunswick, music, November meeting	15.00
	W. N. Hughes, printing postal cards and envelopes,	63.00
	Miss J. M. Ham, salary for November	50.00
27	Charles W. Sherman, advertising agent	55.25
December 11	Suffolk Engraving and Electrotyping Company, plates	48.79
	Amount carried forward	$3 691.06

	Amount brought forward	$3 691.06
December 11	Richard K. Hale, salary to October 1, 1909 . . .	75.00
	Richard K. Hale, expenses	7.60
	D. Gillies' Sons, printing	7.75
	L. M. Bancroft, salary to December 31, 1909 . . .	50.00
	The Brunswick, music, December meeting	15.00
1910.		
January 6	Samuel Usher, September JOURNAL and reprints .	504.50
	Suffolk Engraving and Electrotyping Company, plates	33.60
	Albert S. Glover, telephone service	17.22
	Walter L. Beals, dues retained, L. P. Thomas . .	7.00
	Miss J. M. Ham, salary for December	50.00
	Miss J. M. Ham, sundry expenses	17.86
	Willard Kent, salary to December 31, 1909 . . .	50.00
	Willard Kent, sundry expenses	40.25
		$4 566.84

The Editor, Mr. Richard K. Hale, submitted the following report:

Report of the Editor.

Boston, January 12, 1910.

To the New England Water Works Association, — I present the following report for the Journal of the New England Water Works Association for the year 1909.

The accompanying tabulated statements show in detail the amount of material in the Journal; the receipts and expenditures on account of the Journal for the past year (including the cost of the December Journal and reprints, bills for which were received too late to pay in 1909, and which are consequently not included in the Secretary's and Treasurer's statements); and a comparison with the conditions of preceding years.

Size of Volume. — The volume is somewhat smaller in total pages and pages of text than that of several preceding years.

Illustrations. — The total cost of illustrations for the year, including printing, has been $227.77, or 7.3 per cent. of the gross cost of the volume.

Reprints. — The usual fifty reprints of papers have been furnished to authors without charge, and additional reprints, when desired, at the cost of the paper and press work. Advance copies of four of the papers presented during the year have also been printed, three of which have not yet appeared in the Journal. The net cost to the Association for reprints and advance copies has been $131.35 (assuming that the December reprints chargeable to members are promptly paid for).

Circulation. — The present circulation of the Journal is:

Members, all grades	715
Subscribers	62
Exchanges	25
Total	802

an increase of 22 over the preceding year.

Advertisements. — The December issue contained 23½ pages of paid advertising, which, if maintained throughout the year, would mean an annual income from this source of $1 640. A year ago the figures were 25½ pages and $1 760, showing considerable decrease during the year.

Pipe Specifications. — During the year the specifications for cast-iron pipe to the value of $57.20 have been sold. Five hundred copies have been printed, at a cost of $27.50, representing a net gain of $29.70 for the year. The net gain up to a year ago had been $161.50, so that the total net gain from this source to date is $191.20. There are still about one hundred and forty-eight copies of specifications on hand, or about $14.80 worth if sold at retail.

The Association has a credit of $5.05 at the Boston Post-office, being the balance of the money deposited for payment of postage upon the Journal at

pound rates. I know of no outstanding bills against the Association on account of the JOURNAL.

Respectfully submitted,

RICHARD K. HALE, *Editor.*

TABLE No. 1.

STATEMENT OF MATERIAL IN VOLUME XXIII, JOURNAL OF THE NEW ENGLAND WATER WORKS ASSOCIATION, 1909.

Number.	Date.	Pages of								
		Papers.	Proceedings.	Total Text.	Index.	Advts.	Cover and Contents.	Inset Plates.	Total.	Cuts.
1	March	105	39	144	–	27	4	5	180	—
2	June	78	6	84	–	27	4	7	122	13
3	September	128	14	142	–	27	4	8	181	9
4	December	77	12	89	7	27	4	17	144	6
	Total	388	71	459	7	108	16	37	627	28

TABLE No. 2.

RECEIPTS AND EXPENDITURES ON ACCOUNT OF VOLUME XXIII, JOURNAL OF THE NEW ENGLAND WATER WORKS ASSOCIATION, 1909.

RECEIPTS.		EXPENDITURES.	
From advertisements . .	$2 060.00	For printing JOURNAL . .	$2 044.09
From sale of JOURNALS .	69.25	For preparing illustrations,	132.26
From sale of reprints . .	32.92	For editor's salary	300.00
From sale of cuts	6.00	For editor's incidentals .	35.20
Subscriptions	192.00	For advertising agent's commissions	227.50
	$2 360.17	For reporting	191.25
Net cost of JOURNAL . . .	750.98	For reprints	131.35
		For advance copies . . .	49.50
	$3 111.15	Gross cost of JOURNAL . .	$3 111.15

TABLE No. 3.

COMPARISON BETWEEN VOLUMES XV TO XXIII, INCLUSIVE, JOURNAL OF THE NEW ENGLAND WATER WORKS ASSOCIATION.

	4 Numbers of Vol. XV. 1900–1901.	Vol. XVI. 1902.	Vol. XVII. 1903.	Vol. XVIII. 1904.	Vol. XIX. 1905.	Vol. XX. 1906.	Vol. XXI. 1907.	Vol. XXII. 1908.	Vol. XXIII. 1909.
Average edition (copies printed),	1 200	1 200	1 200	900	900	900	1 085	1 000	1 000
Average membership	586	571	587	596	625	665	693	699	710
Circulation at end of year	617*	648*	656*	667	705	767	785	780	802
Pages of text	363	403	430	491	587	495	500	500	459
Pages of text per 1 000 members	618	707	733	824	939	745	722	715	646
Total pages, all kinds	536	584	619	794	784	662	669	681	627
Total pages per 1 000 members	913	1 020	1 051	1 332	1 254	995	964	976	884
GROSS COST:									
Total	$2 194.26	$2 439.99	$2 706.05	$2 928.77	$3 266.65	$2 573.61	$2 643.42	$2 733.61	$3 111.15
Per page	4.10	4.18	4.38	3.69	4.17	3.88	3.95	4.01	4.97
Per member	3.75	4.27	4.61	4.91	5.23	3.87	3.82	3.91	4.39
Per member per 1 000 pages	6.99	7.32	7.46	6.18	6.67	5.85	5.70	5.88	7.00
Per member per 1 000 pp. text	10.13	10.60	10.72	10.00	8.91	7.81	7.62	8.02	9.56
NET COST:									
Total	$332.90	$622.89	$770.62	$648.11	$1 072.95	$387.96	$483.15	$131.06	$750.98
Per page	.62	1.07	1.25	.82	1.37	.58	.72	.19	1.21
Per member	.57	1.09	1.31	1.09	1.72	.58	.70	.19	1.07
Per member per 1 000 pages	1.06	1.87	2.12	1.30	2.20	.88	1.04	.28	1.70
Per member per 1 000 pp. text	1.57	2.71	3.05	2.22	2.93	1.18	1.39	.39	2.33

* Exclusive of three hundred sample copies.

Mr. George Cassell, Chairman of Auditing Committee, submitted the following report:

REPORT OF AUDITING COMMITTEE.

JANUARY 7, 1910.

We herewith certify that we have examined the books and accounts of the Secretary and Treasurer of the New England Water Works Association and find same correctly kept, with the several disbursements supported by proper vouchers duly approved.

We are pleased to report that the assets of the Association have increased seven hundred and seventy-seven dollars and twenty-seven cents ($777.27) during the year.

Respectfully submitted,

GEORGE CASSELL,
JOHN C. CHASE,
Auditing Committee.

On motion of Mr. Charles W. Sherman, it was voted that the reports of the several officers be accepted, placed on file, and published in the JOURNAL.

The first paper of the afternoon was by Marshall O. Leighton, chief hydrographer, United States Geological Survey, Washington, D. C., on "Governmental Policy in Relation to Water Powers." The paper was discussed by Prof. Dugald C. Jackson, Prof. George F. Swain, and Prof. Dwight Porter.

Dr. William P. Mason, professor of chemistry, Rensselaer Polytechnic Institute, Troy, N. Y., spoke on "The Maidstone Typhoid Epidemic." Mr. Robert S. Weston spoke briefly in regard to Ground Water Supplies.

Mr. H. O. Lacount, chairman, submitted a report for the committee to prepare a standard specification for fire hydrants. The matter was discussed by Mr. F. M. Griswold, Mr. George A. Stacy, Mr. William F. Sullivan, Mr. George H. Snell, and Mr. Charles W. Sherman. The report was received as a report of progress, and the committee continued.

ELECTION OF OFICERS.

Mr. J. W. Crawford, in behalf of the tellers appointed to canvass ballots for officers for the ensuing year, submitted the following report.

Whole number of ballots	252
Blank	6
Imperfect	4

For President.

GEORGE A. KING	240
ALLEN HAZEN	1
N. M. BAKER	1

For Vice-Presidents.

ALLEN HAZEN	240
ERMON M. PECK	237
MICHAEL F. COLLINS	237
LEONARD METCALF	239
IRVING S. WOOD	236
FRANK A. MCINNES	238
W. W. CLARK	1
CHARLES R. BETTES	1
R. C. P. COGGESHALL	1

For Secretary.

WILLARD KENT	240

For Treasurer.

LEWIS M. BANCROFT	239

For Editor.

RICHARD K. HALE	241

For Advertising Agent.

ROBERT J. THOMAS	239

For Additional Members of Executive Committee.

GEORGE A. STACY	238
GEORGE W. BATCHELDER	238
EDWIN C. BROOKS	238

For Finance Committee.

JOHN C. CHASE	238
GEORGE H. FINNERAN	237
ALBERT L. SAWYER	237

Respectfully submitted,

JOHN W. CRAWFORD.
GEORGE A. P. BUCKMAN.

The President declared the officers elected and presented Mr. King, the new President, who said: "I desire to express my thanks for the great honor you have done me, and I pledge to do

all in my power to serve you in the coming year. I trust that you will overlook all my shortcomings."

On motion of Mr. M. F. Collins, a vote of thanks was tendered the retiring President, Mr. Thomas, "for the very able manner in which he has conducted the business of the Association during the past year."

Adjourned.

FINANCIAL ANALYSIS OF TREASURER'S ANNUAL REPORT.

RECEIPTS.

Cash on hand January 6, 1909				$2 711.10
Dividends, coupons, and interest				201.01
Initiation fees:				
Members previous to 1909	$6.00			
During 1909	152.00			
		$158.00		
Associate members, 1909		80.00		
Total initiation fees			$238.00	
Annual dues:				
Members previous to 1909	$29.00			
During 1909	1 971.00			
For 1910	3.00			
		$2,003.00		
Associate members, 1909		782.50		
Total annual dues			2 785.50	
Total received from members				3 023.50
JOURNAL, 1909:				
Advertisements	$1 620.00			
Subscriptions	189.00			
Sale of JOURNALS	68.25			
Sale cuts and reprints	9.60			
		$1 886.85		
JOURNAL, previous to 1909		19.80		
Total received from JOURNAL				1 906.65
Miscellaneous receipts, 1909:				
June excursion	$113.00			
Sale of pipe specifications	56.40			
Sale of Buttons	3.75			
Sale of Index	1.00			
Total miscellaneous receipts				174.15
Total receipts				$8 016.41

EXPENDITURES.

JOURNAL:			
Advertising agent, commission, 1908	$62.00		
1909	171.50		
		$233.50	
Plates		132.26	
Printing		1 334.47	
Editor, salary		225.00	
Expense		28.20	
Reporting		138.75	
			$2 092.18
Office:			
Secretary, salary		$200.00	
Expense		119.10	
Assistant Secretary, salary		600.00	
Expense		144.77	
Rent, 1908	$133.33		
1909	166.67		
		300.00	
Telephone toll charges		17.22	
Typewriter repairs		16.74	
Membership list		173.00	
Library		9.00	
Stationery		68.98	
Miscellaneous printing		19.00	
			1 667.81
Meetings and Committees:			
Stereopticon		$67.70	
Music		75.00	
June excursion		152.00	
Badges		50.00	
Burgee		10.00	
Circulars		169.45	
Envelopes		154.75	
Library research		18.45	
			697.35
Treasurer's salary and bond			65.00
Pipe specifications			27.50
Miscellaneous expenses			17.00
Total expense			$4 566.84

Assets and Liabilities.

ASSETS.			
Cash in banks			$3 449.57
Bonds, market value			1 900.00
Accounts receivable:			
Initiation fees	$11.00		
Annual dues	7.00		
		$18.00	
JOURNAL:			
Advertising	$440.00		
Subscriptions	3.00		
Sale of JOURNAL	1.00		
Sale cuts and reprints	29.32		
		473.32	
Total accounts receivable			491.32
Postage deposit			5.05
Total assets			$5 845.94

LIABILITIES.	
Accounts payable:	
Advertising agent's commissions	$56.00
Editor, salary	75.00
Expense	7.00
Printing December JOURNAL	854.97
December reprints	35.50
Reporting	52.50
Rent	133.33
Circulars	18.50
Library research	3.20
Total account payable	$1 236.00
Surplus	4 609.94
	$5 845.94

February Meeting.

Hotel Brunswick,
Boston, February 9, 1910.

The President, George A. King, in the chair.
The following members and guests were present:

Members.

C. H. Baldwin, A. F. Ballou, L. M. Bancroft, F. A. Barbour, G. W. Batchelder, F. D. Berry, A. E. Blackmer, J. W. Blackmer, E. C. Brooks, G. A. P. Bucknam, W. L. Butcher, J. C. Chase, C. E. Childs, R. C. P. Coggeshall, M. F. Collins, F. W. Dean, J. C. DeMello, Jr., A. O. Doane, E. R. Dyer, E. D. Eldredge, F. F. Forbes, F. J. Gifford, A. S. Glover, F. H. Gunther, R. A. Hale, R. K. Hale, F. E. Hall, Allen Hazen, M. F. Hicks, F. S. Hollis, J. L. Howard, W. S. Johnson, E. W. Kent, Willard Kent, Patrick Kieran, F. C. Kimball, G. A. Kimball, G. A. King, Emil Kuichling, E. E. Lochridge, F. A. McInnes, S. H. McKenzie, N. A. McMillen, D. E. Makepeace, W. E. Maybury, John Mayo, G. F. Merrill, Leonard Metcalf, William Naylor, A. S. Negus, F. L. Northrup, O. E. Parks, E. M. Peck, T. A. Peirce, H. E. Royce, H. W. Sanderson, A. L. Sawyer, E. M. Shedd, C. W. Sherman, W. E. Smith, G. H. Snell, G. A. Stacy, J. T. Stevens, W. F. Sullivan, L. A. Taylor, H. L. Thomas, W. H. Thomas, W. H. Vaughn, E. S. Tucker, C. K. Walker, L. R. Washburn, R. S. Weston, Elbert Wheeler, G. E. Winslow, I. S. Wood. — 75.

Associates.

Anderson Coupling Company, by Charles E. Pratt; Builders Iron Foundry, by A. B. Coulters; Chapman Valve Manufacturing Company, by H. L. DeWolf; Darling Pump and Manufacturing Company (Ltd.), by H. H. Davis; F. H. Hayes Machinery Company, by F. H. Hayes; Hersey Manufacturing Company, by Albert S. Glover; International Steam Pump Company, by Samuel Harrison; Lead-Lined Iron Pipe Company, by T. E. Dwyer; Ludlow Valve Manufacturing Company, by H. F. Gould; Charles Millar & Son Company, by Charles F. Glavin; H. Mueller Manufacturing Company, by George A. Caldwell; National Meter Company, by Charles H. Baldwin, J. G. Lufkin, and H. L. Weston; Neptune Meter Company, by H. H. Kinsey; Norwood Engineering Company, by H. W. Hosford; Pitometer Company, by James F. Flaherty; Pittsburg Meter Company, by F. L. Northrop; Rensselaer Manufacturing Company, by C. L. Brown; A. P. Smith Manufacturing Company, by F. N. Whitcomb; Thomson Meter Company, by E. M. Shedd; Union Meter Company, by Frank E. Hall; United States Cast-Iron Pipe and Foundry Company, by F. W. Nevins; Waldo Bros., by James G. Lincoln; R. D. Wood & Co., by W. F. Woodburn. — 25.

GUESTS.

S. D. Soule, superintendent, Gardiner, Me.; F. W. Dinwiddie, Gardner, Mass.; H. B. Eldredge, Jr., and M. Craven, East Greenwich, R. I.; Z. R. Forbes, water registrar, Brookline, Mass.; Samuel C. Prescott, Boston; J. F. Barry, Westfield, Mass., and Everett S. Locke, water registrar, Lexington, Mass.; Harvey S. Chase, Boston. — 9.

Applications for membership, properly endorsed and approved by the Executive Committee, were presented by the Secretary from the following: Albert H. Wehr, Baltimore, Md., vice-president and general manager of the Baltimore County Water and Electric Company; A. E. Walden, Baltimore, Md., superintendent and chief engineer of the Baltimore County Water and Electric Company; Gordon Peacock, Jr., Centerville, Ia., superintendent of Centerville Water Works; Philip Arthur Potter, New York City, engaged in electrolytic and water-works investigations, meter testing and water-works construction; Wilson F. Monfort, St. Louis, Mo., consulting chemist in water-works problems; John J. Moore, Hingham, Mass., engaged in laying out and building water works; Elbert C. Aldrich, Auburn, N. Y., city engineer; Walter C. Hopper, Paterson, N. J., superintendent Acquacknonk Water Company.

The Secretary was directed to cast the ballot of the Association in favor of the applicants, and he having done so they were declared duly elected members of the Association.

The President announced that the first business in order was the consideration of the following proposed amendments to the Constitution:

Amend Section 3, Article II, by adding:

"*Provided, however,* that Honorary Members elected from the members of the Association shall not thereby lose the right to vote and to hold office."

Amend Section 5, Article III, by striking out the word "ten" and inserting in place thereof the word "four," so as to read as follows:

SECTION 5. The annual membership dues shall be payable in advance on the date of the annual meeting in January. At the expiration of four months after the annual meeting, the Secretary shall notify each member who has not paid his dues for the current year that unless the same are paid within thirty days his membership in the Association shall cease; and if said dues are not paid within said period, the Secretary shall drop the name of said member

from the membership roll. The Executive Committee may, however, at its discretion reinstate said person on the payment of all arrears.

Amend Section 3, Article VI, in third line by striking out the word "quarterly" and inserting the word "monthly," so that it shall read as follows:

SECTION 3. The Secretary shall conduct the official correspondence of the Association, shall collect and receipt for all fees and dues, and transmit the same to the Treasurer monthly, taking his receipt therefor; he shall issue notices of all meetings of the Association at a date not less than two weeks prior to the time appointed for such meetings. He shall make a report to the Association at the annual meeting of the general condition of the Association, and especially of changes in the membership.

THE PRESIDENT. I will call on Mr. Sherman to state the reasons for the proposed changes.

MR. CHARLES W. SHERMAN.* Mr. President: The first amendment, which suggests that honorary members who have been elected from the regular membership of the Association shall not thereby lose the right to vote and to hold office, is merely to formally legalize the practice which the Association adopted some years ago when it elected Professor Sedgwick as president. He, like several others of our honorary members, had been an active member of the Association for many years, and it would seem in many ways an injustice that such persons should lose the right to vote and to hold office, and it never was the intention, I am sure, when the original constitution was adopted, that they should do so. The Association has assumed that to be the case in electing Professor Sedgwick to its presidency while he was an honorary member, but it seemed best, in order that there should be no question in the future about this, to introduce this amendment and make it a sure thing, so far as the constitution is concerned.

The second amendment, requiring that members shall pay their dues within four months, or else be subject to suspension within a further period of a month, has been suggested because the present method of allowing them ten months in which to pay has resulted in many members, through carelessness or otherwise, laying their notices aside and forgetting all about the matter for nearly the whole year, and then, when they do get their final notice, the returns often do not get in before the end of the year. The Secretary has no discretion, but must drop these members from the roll,

* Principal Asst. Engineer, with Metcalf & Eddy, Consulting Engineers, Boston, Mass.

and it results in reporting at the annual meeting a number of members dropped for non-payment of dues who haven't any intention of getting dropped, as is evidenced by the fact that most of them get reinstated within a month after the beginning of the new year. It is better business in every way that the money should be collected more promptly, it will be no hardship on the members, and it will also result in allowing time enough for reinstatement of members who have carelessly allowed themselves to get suspended, and have the membership roll cleared at the time of the annual meeting.

In regard to the third amendment, it has been the practice of the Secretary, I believe, to transmit funds to the Treasurer nine or ten times a year, depending on the amount of collections. Often the collections would be so great within the quarterly period that they would constitute a much larger sum than the Secretary would care to carry in his hands, while, on the other hand, if such a sum were held back, it might be a serious embarrassment to the Treasurer in paying the bills incurred by the Association. Consequently, it has seemed best to make a constitutional provision that the amounts received by the Secretary should be turned over monthly.

Mr. R. C. P. Coggeshall.* I was one who had a good deal to do with the framing of the constitution, and I can say that I never was more surprised in my life than when I found out that under its provisions honorary members were possibly deprived of the right of voting. I always supposed that they had that privilege, and it certainly was the intention at the time the constitution was framed that they should not be deprived of it.

The President thereupon put the question on the adoption of the several amendments proposed, and each was adopted by more than a two-thirds vote.

The first paper upon the program for the afternoon was "Depreciation in Water Works Accounts, with Reference to Uniform Reports," by Harvey S. Chase, Esq., certified public accountant, Boston. It was discussed by Gen. Elbert Wheeler, Mr. Allen Hazen, Mr. George A. Kimball, Mr. Charles W. Sherman, Mr. Francis W. Dean, Mr. Frank C. Kimball, Mr. Leonard Metcalf,

* Superintendent of Water Works, New Bedford, Mass.

Mr. Samuel H. McKenzie, Mr. Edwin C. Brooks, Mr. George A. Stacy, and Mr. R. C. P. Coggeshall.

Mr. A. O. Doane, division engineer, Metropolitan Water and Sewerage Board, Boston, read a paper on "The Purchase of Coal on Efficiency Basis." The subject was discussed by Mr. Harry L. Thomas, Mr. A. S. Negus, Mr. Francis W. Dean, Prof. Frederick S. Hollis, and Mr. Edward D. Eldredge.

Adjourned.

EXECUTIVE COMMITTEE.

Meeting of the Executive Committee of the New England Water Works Association at headquarters, Boston, Mass., December 8, 1909.

Present: President Robert J. Thomas, and members George A. King, George A. Stacy, Ermon M. Peck, George W. Batchelder, L. M. Bancroft, Richard K. Hale, Charles W. Sherman, William F. Sullivan, and Willard Kent.

Applications for membership were received as follows: Elliot R. B. Allardice, superintendent Wachusett Department of Metropolitan Water Works, Clinton, Mass.; and M. J. Rosenau, Department of Preventive Medicine, Harvard Medical School, 82 Stedman Street, Brookline, Mass.

Voted: That above-named applicants be recommended to the Association for membership.

Voted: On motion of Mr. Sherman, that it be recommended to the Association that Article II, Section 3, of the Constitution be amended as follows: By adding at the end thereof the words, "Provided, however, that Honorary Members elected from the Members of the Association shall not thereby lose the right to vote and to hold office," so as to read as follows:

SECTION 3. Members only shall be eligible to office and entitled to the right to vote, provided, however, that Honorary Members elected from the Members of the Association shall not thereby lose the right to vote and to hold office.

Voted: On motion of Mr. Sherman that it be recommended to the Association that Article III, Section 5, of the Constitution be amended by striking out the word "ten" and inserting in place thereof the word "four," so as to read as follows:

SECTION 5. The annual membership dues shall be payable in advance on the date of the annual meeting in January. At the expiration of four months after the annual meeting the Secretary shall notify each member who has not paid his dues for the current

year that unless the same are paid within thirty days his membership in the Association shall cease; and if said dues are not paid within said period, the Secretary shall drop the name of said member from the membership roll. The Executive Committee may, however, at its discretion, reinstate said person on the payment of all arrears.

Place of holding next annual convention was discussed and the Secretary instructed to correspond with the city of Rochester, N. Y., in relation thereto.

Voted: That the President appoint a committee of seven to take action relative to increasing the membership of the Association.

Voted: On motion of Mr King, " that a meeting of the Association be held in the city of Hartford, Conn., on the second Wednesday of April next."

Adjourned.

WILLARD KENT, *Secretary.*

Meeting of the Executive Committee of the New England Water Works Association at headquarters, Boston, Mass., January 12, 1910.

Present: President Robert J. Thomas, and members L. M. Bancroft, Charles W. Sherman, William F. Sullivan, Richard K. Hale, George W. Batchelder, Ermon M. Peck, George A. King, George A. Stacy, and Willard Kent.

Applications were received from Lewis R. Dunn, superintendent Water Department, Winthrop, Mass.; George A. Sampson, civil engineer, Cambridge, Mass.; and Walton Van Winkle, chemist, Seattle, Wash., for membership; and from Julian d'Este Company, manufacturers of engineering specialties, Boston, Mass., for associate membership.

All were by vote recommended for admission.

Fifteen delinquents having paid their dues were by vote re-instated to membership.

Voted: That it be recommended that Article VI, Section 3, of the Constitution be amended by striking out the word " quarterly " in the third line and inserting the word " monthly," so that it shall read:

SECTION 3. The Secretary shall conduct the official correspondence of the Association, shall collect and receipt for all fees and dues, and transmit the same to the Treasurer monthly, taking his receipt therefor; he shall issue notices of all meetings of the Association at a date not less than two weeks prior to the time appointed for such meetings. He shall make a report to the Association at the annual meeting of the general condition of the Association and especially of changes in the membership.

Voted: That proposed changes in By-Laws appear with the notice of the next regular meeting.

Voted: That the annual convention of this Association for 1910 be held at Rochester, N. Y.

Adjourned.

WILLARD KENT, *Secretary.*

WEDNESDAY, January 12, 1910, 5 P.M.

A meeting of the Executive Committee of the New England Water Works Association was held at the Brunswick Hotel immediately after the annual meeting.

Present: President George A. King, and members Lewis M. Bancroft, Michael L. Collins, Richard K. Hale, Willard Kent, Frank A. McInnes, Ermon M. Peck, George A. Stacy, Robert J. Thomas, and Irving S. Wood.

Voted: To hold the June outing in Providence, R. I. The President appointed the following committee of arrangements to serve with him: I. S. Wood, A. B. Lisle, and F. N. Connet.

The President was authorized to appoint a committee to consider the advisability of incorporating the Association. The following were appointed to serve with the President: Messrs. Leonard Metcalf and Frank A. McInnes.

The President was authorized to appoint a committee to arrange for the special meeting in Hartford, Conn., on April 13. The following were appointed: Messrs. Ermon M. Peck, Henry Roberts, Fred D. Berry, A. E. Martin, John H. Walsh, and W. E. Johnson.

Adjourned.

WILLARD KENT, *Secretary.*

Meeting of the Executive Committee of the New England Water Works Association at headquarters, Tremont Temple, Wednesday, February 9, 1910.

Present: President George A. King, and members Allen Hazen, Ermon M. Peck, Michael F. Collins, Leonard Metcalf, Irving S. Wood, Frank A. McInnes, George A. Stacy, George W. Batchelder, Edwin C. Brooks, Lewis M. Bancroft, Richard K. Hale, and Willard Kent.

Eight applications were received and the applicants were by unanimous vote recommended for membership, viz.,

Albert H. Wehrn, vice-president and general manager, Baltimore County Water and Electric Company, Baltimore, Md.; A. E. Walden, superintendent and engineer, Baltimore County Water and Electric Company, Baltimore, Md.; Gordon Peacock, Jr., superintendent Centerville Water Works, Centerville, Ia.; Philip Arthur Potter, water-works investigations and construction, New York City; Wilson F. Monfort, consulting chemist in water-works problems, St. Louis, Mo.; J. J. Moore, water-works construction, Hingham, Mass.; Elbert C. Aldrich, city engineer, Auburn, N. Y.; Walter C. Hopper, superintendent Acquackanock Water Company, Passaic, N. J.

Voted: That the President be and hereby is authorized to appoint a committee with full powers to make arrangements for the Annual Convention of 1910.

The President was by vote made a committee to attend one meeting of the organization of "Boston, 1915."

The committees on the April and June meetings reported progress, and their arrangements as outlined were endorsed by vote.

Mr. Metcalf, of the Committee on Incorporation, reported, recommending that no action be taken at the present time, and his report was by vote accepted and the recommendation adopted.

On motion of Mr. Collins it was

Voted: That the Committee on the April meeting be and hereby is authorized to issue invitations to the several water companies of Connecticut requesting the attendance of their representatives at that meeting.

Voted, on motion of Mr. Hazen:

That five hundred additional copies of the JOURNAL containing

Report of Committee on the Collection of Data Relating to Awards that have been Made for Damages Resulting from the Diversion of Water be printed and that they be furnished to members at the regular rate, and to parties not members of the Association at the rate of two (2) dollars per volume.

Adjourned.

WILLARD KENT, *Secretary.*

Meeting of the Executive Committee, at headquarters, 715 Tremont Temple, Wednesday, February 16, 1910.

Present: President King, and members Leonard Metcalf, Richard K. Hale, Michael F. Collins, Robert J. Thomas, Ermon M. Peck, and Willard Kent.

The President stated the object of the meeting to be the consideration of the subject of increased membership.

Voted: That the President appoint a committee to consider the subject of increased membership, with power to act.

The President appointed the following as members of that committee: C. W. Sherman, F. A. Barbour, E. W. Bemis, Dexter Brackett, J. H. Cook, R. C. P. Coggeshall, F. F. Forbes, Murray Forbes, Henry Roberts, J. Waldo Smith, F. P. Stearns, and F. H. Pitcher.

The President appointed the following Committee on the Annual Convention: Edwin A. Fisher, Beekman C. Little, and Emil Kuichling.

Adjourned.

WILLARD KENT, *Secretary.*

OBITUARY.

Earle Harley Gowing.*

Died November 24, 1909.

Earle Harley Gowing was born in Woburn, Mass., July 10, 1853. His parents were Ames Gowing, born in South Reading, Mass., and Emma Genever Reed, born in Boston, Mass. He was the seventh lineal descendant of Robert Gowing, who was born in 1618 in Edinburgh, Scotland, and came to Dedham, Mass.

On graduating from the Reading High School, Mr. Gowing entered the Massachusetts Institute of Technology in 1874 as a special student in civil engineering, remaining until 1877. After leaving the Institute he entered the George F. Blake Manufacturing Company's shop in Cambridge, remaining until 1880, when he accepted a position with the Deane Steam Pump Company, working in the shop at Holyoke and in the office in New York City, and later in St. Louis. In 1883 he became assistant to George H. Barrus, consulting steam engineer and expert. From 1885 to 1888 he was engaged with B. C. Mudge, New England agent for Henry R. Worthington, selling pumping machinery, and later he constructed water works in Bath, Skowhegan, and Eastport, Me., and in Grafton, Mass. From 1888 to 1891 he completed the unfinished water works in Skowhegan, Me., and built water works at Fort Fairfield, in addition to being engaged in general engineering work.

In 1891 he entered into partnership with John J. Moore, of Hingham, Mass., under the firm name of Moore & Co., with whom he was associated at the time of his death. The firm is engaged in engineering and the construction of public works, making a specialty of water works and general contracting work. Among the water works built by this firm may be mentioned those at White-

* Memoir prepared by Richard A. Hale and Lewis M. Bancroft.

field, Lancaster, Gorham, Colebrook, N. H.; Boothbay Harbor, Phillips, Newport, Millinocket, Van Buren, Searsport, Dixfield, Me.; and Scituate, Mass.

During this period Mr. Gowing served as engineer of the water works at Machias and Oakland, Me., and engineer of the works at St. Johnsbury, Vt. He was one of the commissioners to appraise the value of the water works at Farmington, Me., and one of the commission for valuing the works at North Conway, N. H.

In 1891 Mr. Gowing entered into partnership with Mr. Barrus, under the firm name of Gowing & Co., and published the book of "Boiler Tests," written by Mr. Barrus, followed later by the publication of "Engine Tests."

Mr. Gowing was the inventor of the Gowing jointer, a device for making joints in cast-iron water pipe, which has had a large sale.

Mr. Gowing was the founder of, and, with his partner, a large owner in, the Millinocket Trust Company, Millinocket, Me. It was in their building, where he had gone for a few days to take the cashier's place in his absence, that the gas explosion occurred which caused the terrible injuries resulting in his unfortunate death.

Mr. Gowing was president and promoter of the Whitehead Association at Nantasket, and also president of the Hull and Boston line of steamers that ply between Boston and Nantasket Point.

He was the engineer and promoter of the Hingham Street Railway Company, now owned by the Massachusetts Electric Companies, and was the president of the Colebrook Water Company, and the treasurer of the Phillips Water Company, the Millinocket Water Company, the Millinocket Light Company, and the Frontier Water Company.

He was a director of all the above companies, and also of the Searsport Water Company, the Dixfield Water Company, the Scituate Water Company, the Cohasset Water Company, and the Liberty Trust Company, Boston.

Mr. Gowing was a member of the Water Board of Reading, Mass., where he had been engaged for the past five years in investigating methods of purifying and improving the water supply.

He was also member of the following societies and clubs: Boston

Society of Civil Engineers, New England Water Works Association, Technology Club, Exchange Club, Boston City Club, Economic Club, Boston Yacht Club, Unity Yacht Club, Porter's Yacht Club, Good Samaritan Lodge, A. F. & A. M., Reading; Melrose Lodge, No. 1031, B. P. O. E.

During the three years of intimate association with him at Technology, his earnestness in his work and loyalty to all traditions of school, professors, classmates, won the respect of all.

Mr. Gowing married Isabelle P. Dinsmoor, September 16, 1883, who with an adopted daughter survive to mourn his loss.

Mr. Gowing was elected a member of the New England Water Works Association, April 21, 1885.

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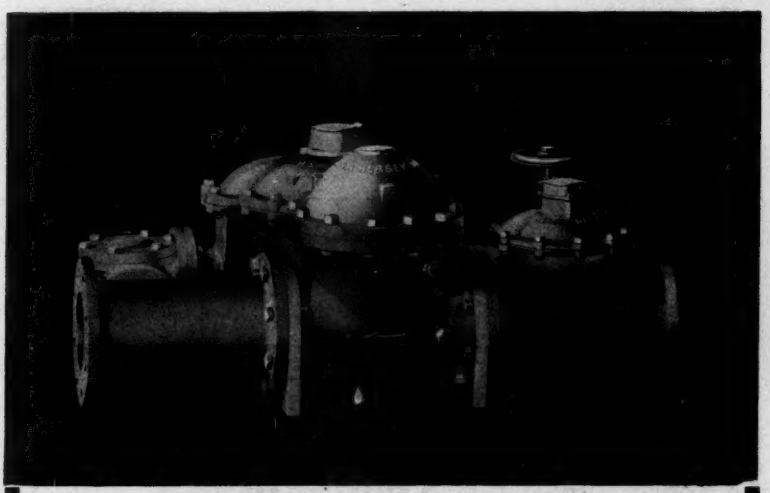

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ACCURACY, LONG LIFE,

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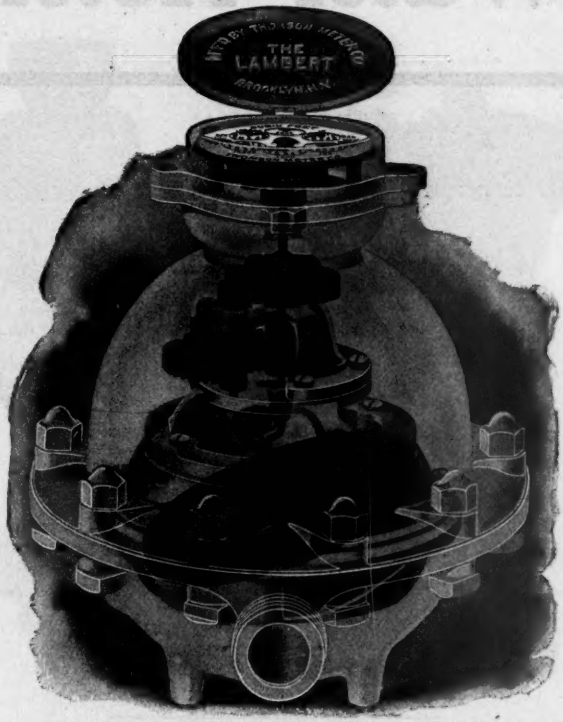
Are the Requisites of the Perfect Water Meter and are the Principal Features of the

"LAMBERT."



Our unbreakable disk-piston, reinforced with an internal steel plate, can be found only in the **LAMBERT METER.**

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100-110 BRIDGE ST.
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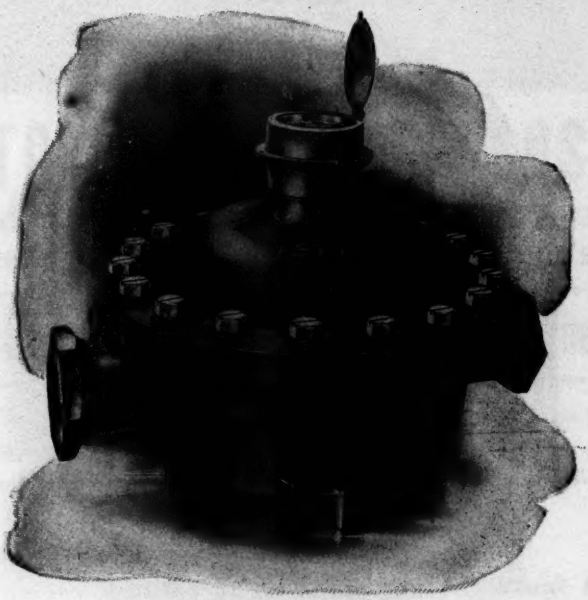
Trident Water Meter

Style 3



The Meter with a thrust roller, to prevent broken disks. All bronze meter, with removable bearings. The only meter that can be adjusted for different pressures. Brass bolts. Brass nut ring. Simple design. Our claim: The meters that earn the most revenue with the least cost for upkeep.

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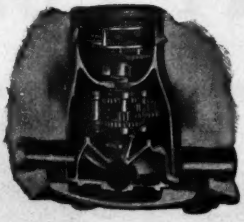

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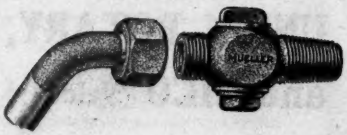
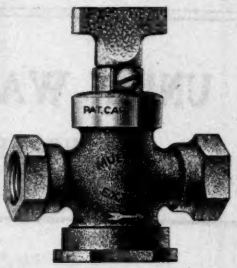
No. 4 MUELLER



No. 6 MUELLER

Corporation and Curb Cocks

No. 78 Curb Cock
Patent Cap



Mueller Corporation Cocks are made of red brass, carefully cored for evenly balanced walls, keys smoothly ground and polished into the body.

Mueller Patent Cap Inverted Key curb cocks have the strongest check ever devised. Two lugs in the cap operate against two lugs on the rim of the cock. When brought together the cock is certain to be full open or full closed.

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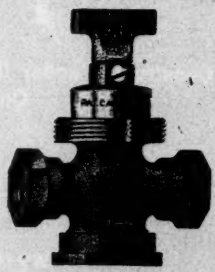

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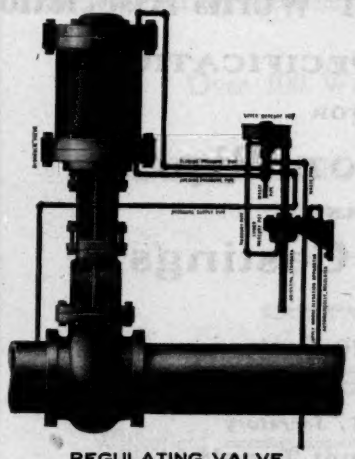

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Governmental Regulation of Water Power, by Marshall O. Leighton. Depreciation in Water Works Accounts, by Harvey S. Chase. Purchase of Coal on an Efficiency Basis, by A. O. Doane. The Maidstone Typhoid Epidemic, by W. P. Mason. Proceedings of the Association.

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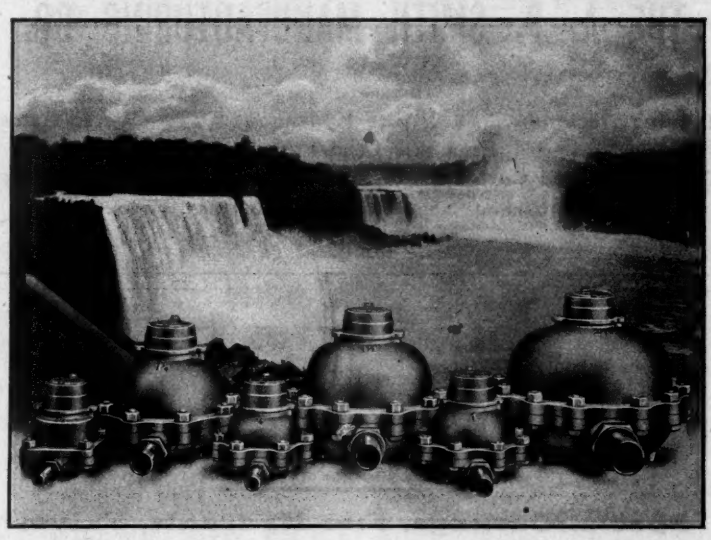

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have one model of high-grade working parts furnished in differently constructed outside casings and fitted with either style of dial. Each meter is assembled and tested with unusual care and precision. Their design, materials and workmanship insure accuracy, durability and satisfaction.

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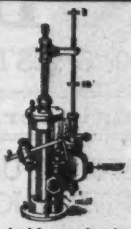

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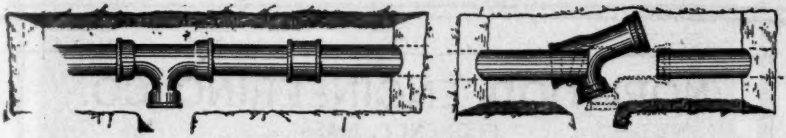

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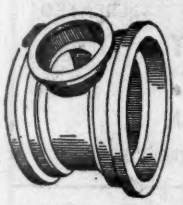

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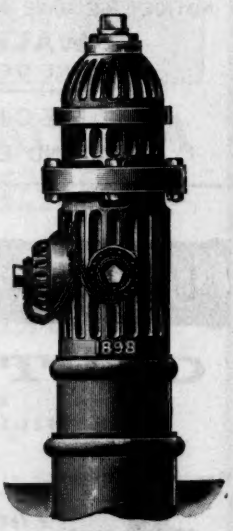

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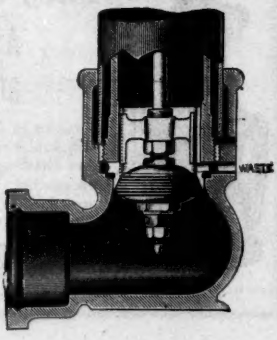
Number in use exceeds total of all other makes combined.



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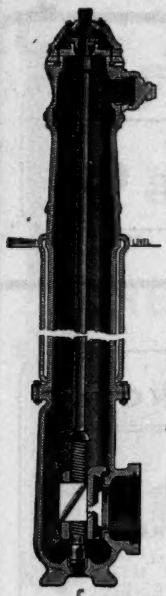

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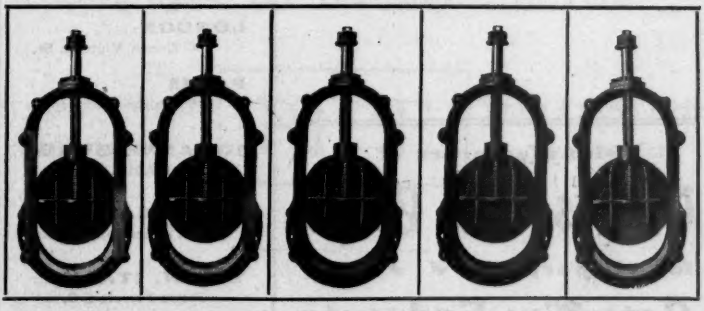

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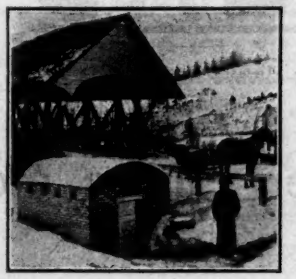
DETECTION OF WASTE WATER

TWO CITIES WHICH SAVED MONEY BY HAVING VENTURI METERS

In the Reservoir Gate House of a certain city was placed in 1900 the Register of a 30-inch Venturi Meter. Its readings showed great waste of water and led to the general adoption of house meters. The daily per capita consumption was then 84 gallons; in 1907 it was 59 gallons. At present only 16% of the Venturi's readings is not accounted for by the small meters.

One day the Water Department gave the street mains a thorough flushing out by opening the fire plugs and some underground blow-off connections to the sewers. After this flushing, the Venturi Meter showed an increased discharge of about 1,500,000 gallons per day, and as this continued for about two weeks it was thought that the increased reading was caused by some derangement of the meter, due to the abnormal flow of the flushing. Nevertheless, *because of the meter readings*, a five days' diligent search for leaks was made and one of the underground blow-off valves was found *open*. As soon as this was closed the meter readings fell off to the previous normal consumption.

It is altogether probable that water would have poured through this valve indefinitely, had it not been for the Venturi Meter.



The Register of the 10-inch Meter at another city is kept in the house shown in our illustration. The temperature is frequently 30° below zero, but the readings are not affected. At one time this meter registered abnormally large quantities of water. A diligent investigation of several days showed that a break in the distributing pipe was carrying large quantities of water directly into the sewer. To those in charge of the Water Company there was absolutely no indication of this leak except that given by the Venturi meter.

Cities with Venturi Meters soon discover such waste of water. It is more than possible that similar losses are taking place in other cities where there are no Venturi Meters to give warning.

BUILDERS IRON FOUNDRY

PROVIDENCE, R. I.

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Corner Congress and Franklin Streets

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Pig Tin, Wire Solder, Pumps, etc.

ALSO

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New York Continental Jewell Filtration Co. ix
Norwood Engineering Co. xv
Ross Valve M'f'g Co. xv

FURNACES, ETC.

H. Mueller Mfg. Co. x
Harold L. Bond & Co. xi
The A. P. Smith M'f'g Co. xiii

GAS ENGINES.

National Meter Co. iii

GATES, VALVES, AND HYDRANTS.

Ashton Valve Co. xv
Chapman Valve M'f'g Co. xviii
Coffin Valve Co. xvii
John Fox & Co. xiii
Ludlow Valve M'f'g Co. xvii
Norwood Engineering Co. xv
Rensselaer M'f'g Co. xix
Ross Valve M'f'g Co. xv
Simplex Valve and Meter Co. xi
The A. P. Smith M'f'g Co. xiii
R. D. Wood & Co. xvi

INSPECTION OF MATERIALS.

Wm. R. Conard xii

LEAD AND PIPE.

Chadwick-Boston Lead Co. xxiv
Lead Lined Iron Pipe Co. xiii

METERS.

Buffalo Meter Co. xiv
Builders Iron Foundry xxiii
Hersey M'f'g Co. iv
National Meter Co. ii
Neptune Meter Co. vi
Pittsburg Meter Co. vii
Simplex Valve and Meter Co. xi
Thomson Meter Co. v
Union Water Meter Co. ix
Henry R. Worthington viii

METER BOXES.

H. W. Clark Co. xii
Hersey M'f'g Co. iv

OIL, GREASE, ETC.

Boston Engineers' Supply Co. xi
Jos. Dixon Crucible Co. xii
Eagle Oil and Supply Co. xxv

PACKING.

Harold L. Bond & Co. xi
Boston Engineers' Supply Co. xi
Eagle Oil and Supply Co. xxv

PAINT.

Eagle Oil and Supply Co. xxv
Semet-Solvay Co. xx

PRESSURE REGULATORS.

H. Mueller Mfg. Co. x
Ross Valve M'f'g Co. xv
Simplex Valve and Meter Co. xi
Union Water Meter Co. ix

PUMPS AND PUMPING ENGINES.

Builders Iron Foundry xxiii
National Meter Co. iii
R. D. Wood & Co. xvi

TAPPING MACHINES.

H. Mueller Mfg. Co. x
The A. P. Smith M'f'g Co. xiii

TOOLS AND SUPPLIES.

Boston Engineers' Supply Co. xi
H. Mueller Mfg. Co. x
Harold L. Bond & Co. xi
The A. P. Smith M'f'g Co. xiii